When Public Relations and Particle Physics Collide: An Ethnographically Informed Account of Life in the CERN Communications Group

Thesis

When Public Relations and Particle Physics Collide: An Ethnographically Informed Account of Life in the CERN Communications Group

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Abstract

This thesis explores how ‘big science’ becomes public within an era of digital scholarship and evolving professional practices. Focusing on research conducted at CERN, I explore the strategic approaches and operational principles and practices of communication professionals and researchers working in High-Energy Physics.

A review of current research into the dissemination of scientific information in the digital age shows a dearth of empirical studies that explore the role of communication professionals within scientific organisations. I argue that communication professionals within scientific organisations play an important intermediary role between scientists, external media professionals and publics, often being the first to mediate information for audiences beyond academia. Such groups, therefore, should be explored in order to understand the role they play in mediating science for the contemporary public sphere. This requires that some account be taken of the context within which the communication is produced. At CERN this includes issues of openness and transparency, organisational structures, whilst also taking account of the role of technology in mediating information.

A mixed methods approach was used, combining document analysis with ethnographic observations and semi-structured interviews to create eight detailed case studies. In my analysis I argue that scientific public relations is integral to the process of mediation, yet has so far been unrepresented within it. This thesis contributes to a wider understanding

of the role organisation plays in the production of High-Energy Physics communication, noting the importance of timing in relation to openness and proposing a methodological approach for the continued research of communications groups in other scientific organisations. Furthermore, this thesis has demonstrated that digital scholarly practices are yet to be fully realised. Instead, a muddled culture of practices exists across CERN, with multiple analogue and digital tools used by individuals and groups working in distinctly separate ways.

Overall, the thesis adds to the growing discussion in a number of fields, including the role of scientific public relations in the process of mediation of scientific information and how digital scholarly practices are enacted within a 'big science' project.

Acknowledgments

Without the continued support of a number of groups and individuals throughout this research, this thesis would not have been possible. First of all, I would like to thank those at the Open University and CERN who have funded this research, in particular, those at the Institute of Educational Technology, the Centre for Research in Education and Educational Technology and the CERN Communications Group who provided advice and resources. I would also like to thank my research participants, especially the members of the Communications Group and experimental and theoretical physicists, who gave up their time to be involved in this study.

The greatest contributors to this thesis have been my supervision team. Dr James Gillies guided me through my time at CERN and gave me a ring side seat as history was made during the 4th of July Higgs Update, while Professor Eileen Scanlon has been a constant source of knowledge and advice at every stage of this research. A particularly big thank you goes to Professor Richard Holliman. Much like his loyalty to Luton Town FC, his support has often been unrewarded, but always appreciated.

Finally, a special mention goes to my friends and family who have patiently waited for this nightmare to end. Nobody has been more supportive then Frankie Lister, who hardly left my side during this time.

Contents

Index of Tables

Index of Figures

Chapter 1 Introduction

1.1 Communicating and Engaging in a Digitally-Mediated Public Sphere

Effective communication is at the heart of good science, a necessity at every stage of the research cycle from the development of ideas to the dissemination of results. Yet, while social exchanges between researchers have become routine in the majority of scientific fields (Bennett, 2012), meaningful engagement with broader sections of society is still lacking among many research institutions across Europe (Bucchi, 2013). As Bucchi (2013) describes, many research institutions lack effective strategies combined with the routine activities that reward, recognise and evaluate such practices, raising questions over the quality of any engagement. While moves towards such measures are occurring, especially within the UK Higher Education sector (Holliman *et al.*, 2015), the impact is not yet clear.

A further issue when it comes to the quality of science communication and public engagement is the context in which such interactions take place, and the impartiality of those mediating scientific information. The digital age in particular has brought with it changes to the 'traditional' communication process, with digital technologies providing channels through which 'producers' can reach 'consumers' of knowledge more directly (Holliman, 2011; Allan, 2006). Where traditional mediators of scientific information, such as journalists and other media professionals, would filter and/or restructure scientific information into genre specific 'products', such tasks are increasingly being undertaken within scientific institutions themselves (Holliman, 2004; 2000). As such, there is a need to understand how this shift in the mediation of scientific information and use of digital technologies is impacting on science communication.

This chapter sets the scene for the thesis, providing an initial look at the wider context of the research area, while discussing prevalent issues and debates in the field of science communication. The chapter concludes with an outline of the proceeding chapters.

1.2 Big Science as a Case Study

'Resource-rich' institutions (Schlesinger, 1990) should be able to commit resources to communicating their research. Yet, as Miller (2002) describes, many resource-rich institutions do not always devote enough resources to such activities. One of the overarching questions this thesis addresses is whether this is the case within a 'big science' project (Weinberg, 1961), such as CERN. As outlined in CERN's 2012-2016 Communications Strategy (CERN, 2011), CERN devotes around 0.25%[1] of its gross revenue to communications functions[2]. It is noteworthy that further resources are spread across other departments and units. As Miller (2002) outlines, this spread of resources across an organisation, even a resource-rich institution, can make the planning and execution of coherent messages difficult, especially when there are multiple groups

[1] The Strategic Communication & Public Relations Centre (2010) recommends private and public organisations should devote 1.3 - 1.9% gross revenue to public relations functions.

[2] This thesis explores what these 'communication functions' are in practice within a big science project.

with competing agendas. It follows that this thesis will explore both organisational culture and issues of resourcing communications and engagement within the context of 'big science'.

The overarching aim of this thesis is to explore how CERN's research becomes public within an era of digital scholarship and the implication of this for academics and communication professionals. Within this, this research adds to the growing discussion of the role of public relations in the process of mediation of scientific information. This is examined through an ethnographically informed case study of the working practices of CERN and their Communications Group. Furthermore, this study explores how digital scholarly practices (Weller, 2011) are enacted within a 'big science' project (Weinberg, 1961).

To achieve this, this study utilises multiple frameworks from a diverse range of fields. In the study of mediation of scientific information, Fahy and Nisbet's (2011) typology of science media professionals was used to explore the function of the CERN Communications Group, with multiple types identified within the group (Chapter 2, Section 2.4.5). Where public relations practices became apparent, Borchelt and Neilson's (2014) levels of public relations were used to examine their effectiveness (Chapter 2, Section 2.4.7). The impact of CERN's organisation on the ability of the CERN Communications Group to carry out such functions was explored through Keyton's (2005) model of organisational culture (Chapter 2, Section 2.2). Finally, Miller *et al's.*

(1998) Circuit of Mass Communication provided the principle model to demonstrate how various actors[3] interact to construct and interpret scientific information. Within this thesis, Miller *et al's*. (1998) model was revisited and adapted within the context of the digital age, with the position of scientific communication (incorporating public relations, communication, engagement, etc.) identified. This identification of public relations functions and other communication and engagement functions within this revisited model of communication provides a useful framework for future research into the role of scientific public relations in the mediation of scientific information.

The other aspect of this study focused on the digital scholarly practices of researchers and media professionals within a scientific institute, in this case CERN. Utilising Grand *et al's.* (2016) typology of digitally engaged researcher, the use of technology by participants was traced to identify how digital scholarly practices are enacted within a digitally mediated ecosystem, where a muddling of practices exists.

1.3 An Introduction to CERN and the Large Hadron Collider

CERN was established in 1954[4] and is host to a community of distinctly separate users spread out across many countries. CERN employs just over 2,400 scientific and technical

[3] In Miller *et al's*. (1998) model, they define four actors: the media, the public, social institutions and decision makers. See Chapter 2, Section 2.5 for a full discussion on this model.

[4] The History of CERN, http://timeline.web.cern.ch/timelines/The-history-of-CERN, last accessed 19.01.2016.

staff that prepare, run, analyse and interpret results from the experiments[5]. Furthermore, over 11,000 'CERN Users'[6], guest and visiting scientists from over 600 universities in 113 countries, carry out their research at CERN[7].

At the centre of CERN's experimental programme is the Large Hadron Collider (LHC). The LHC follows Weinberg's (1961) characterisation of a 'Big Science' project in that it has required major international collaboration, significant public funding and assistance from a multitude of outside organisations, with each group connected via numerous communications channels. A central part of this thesis is to explore the significance of these communications channels within a big science project and the relationship between knowledge production, communications infrastructure and society.

The job of the LHC is to accelerate protons to speeds approaching the speed of light and smash them together. The collisions produce elementary particles that allow researchers to explore the structure of matter. The four main detectors, ATLAS[8] CMS[9] ALICE[10] and LHCb[11] register these collisions and the products created in different ways. The use of

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[5] CERN Member States, http://home.web.cern.ch/about/member-states, last accessed 19.01.2016.

[6] CERN Users' Office, http://usersoffice.web.cern.ch/, last accessed 19.01.2016.

[7] CERN Member States, http://home.web.cern.ch/about/member-states, last accessed 19.01.2016.

[8] ATLAS – A Toroidal LHC Apparatus, http://atlas.ch/, last accessed 19.01.2016.

[9] CMS – Compact Muon Spectrometer, http://cms.web.cern.ch/, last accessed 19.01.2016.

[10] ALICE – A Large Ion Collider Experiment, http://aliceinfo.cern.ch/, last accessed 19.01.2016.

[11] LHCb – Large Hadron Collider Beauty, http://lhcb.web.cern.ch/lhcb/, last accessed 19.01.2016.

multiple detectors, in particular the two "general purpose" detectors CMS and ATLAS (Boisot *et al.*, 2011, p.12), allows results to be independently replicated and verified within the confines of large-scale experimental equipment. Such approaches, while benefiting the methodologies of High-Energy Physics, can cause issues when it comes to communication.

With the LHC producing around 15 petabytes of raw data each year[12], the appropriate digital technologies, culture and practices need to be in place to allow the most efficient handling, sharing and networking of data (Weller, 2011). Furthermore, appropriate communications technologies, cultures and practices need to be in place to allow effective communication, collaboration and engagement (Borgman, 2012). Previously, analogue information and communications technologies (ICT's) allowed interested groups to connect and collaborate across these distances, allowing some form of coherence amongst the collaborations and organisations. Now in the digital age, digital technologies have allowed researchers to create, handle, share and evaluate more data than ever before. But, as Borgman (2012) notes, to benefit from this increase in data, researchers must be prepared to share their data in appropriate ways, ways that make it understandable and accessible to many different groups. As experiments themselves cross into public spaces, requiring increased public funding and impacting on public life,

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[12] CERN: Taking a closer look at the LHC, http://lhc-closer.es/php/index.php?i=1&s=3&p=12&e=0, last accessed 19.01.2016.

science has become involved in local and international levels of debate (Gibbons, 1999). Key here is both the accessibility of data and the mediation between researchers, publics and interest groups, two key aspects of successful scholarship (Weller, 2011; ideas around scholarship and digital scholarship are outlined in Section 2.4).

Access to scientific data and knowledge held on digital platforms can require expensive hardware, connection to specific networks and require specific skills to manoeuvre, a lack of which can limit who can access scientific information (Holliman, 2011). This is particularly true of CERN and the experimental collaborations.

1.3.1 The Culture of CERN

Initial exploration into studies of CERN uncovered a wide range of academic literature, from historical accounts of the organisation and the development of High-Energy Physics (HEP) (Hermann *et al.*, 1987), to ethnographic studies of the nature of large scientific organisations (Knorr-Cetina's, 1999). These studies were carried out at CERN between the 60's and 90's, which together tell the story of how CERN and HEP developed over the years. The earliest uncovered is Pickering's (1984) exploration of the practices of the High-Energy Physics community in the 60s and 70s, as CERN transitioned from an 'old' to a 'new' set of research problems and to different scientific practices. Pickering (1984), studying through a social constructivist lens, attempts to address how the development of new theories in HEP during the late 60’s/early 70’s led to the creation and configuring of new detectors that could investigate these new theories. This study provides the first glimpse into the shifting nature of science (especially HEP), developments of technology and changes in scholarly practices. For Pickering (1984), physics is socially produced with physicists choosing what evidence to seek, with physics 'facts' being theory-influenced judgements based on interpretations of experimental data. Pickering (1984) also begins to discuss the issue of 'incommensurability' during this transitional period, whereby experiments or results of experiments are founded on conflicting presuppositions or produce results that conflict with other theories. Here, incommensurability can create communication breakdowns between supporters of different theories or experimental approaches. These issues can often become more apparent as collaborations grow, with new disciplines and institutions introduced. As such, this needs to be taken account when exploring the communication practices of researchers working at CERN.

The work of Galison (1987) at CERN in the early 1970s further examined this phase in HEP, this time in terms of experimental practice and changes in experimental traditions. Galison (1987) discusses how scientists developed skills in using particular instruments, and how this was linked to whether they find certain types of evidence and data more convincing. Within particle physics, Galison (1987) describes the traditions of visual detectors, such as cloud chambers, compared to the growing 'electronic' tradition. Within the 'electronic' tradition, statistics and the recording of large numbers of events became more significant than observation of single 'golden events’ that characterised the visual tradition. These shifts in traditions were brought about in part due to the nature of the experiments being carried out, when large data records were needed so real effects could be clearly separated from background events. For Galison (1987), the introduction of early 'digital' data collection and analysis was the main change in practice for 20th century physicists. Galison’s (1987) work also demonstrates the continuous link between technology and science, required for collecting, analysing and storing increasing amounts of data.

The third study was Knorr-Cetina's (1999) ethnographic account of the experiments carried out at CERN between 1987 and 1996, a period that included the early development of the LHC. Knorr-Cetina (1999) adopts what she describes as a 'comparative optics' method, in which she investigated CERN and a molecular biology laboratory to highlight the distinctive practices and epistemologies of different natural sciences. It is within Knorr-Cetina's (1999) description of the features and practices of HEP where we begin to see how CERN has developed as an organisation. Compared with the CERN of the 60’s and 70’s, experimental machines became far greater in size and complexity, with the size and diversity of collaborations across disciplines also increasing. With this came further physical separations between members of the collaborations as well as the development of big science at CERN.

There are a number of things that can be taken away from these studies. Firstly, the use of ethnographic techniques to investigate the working practices of physicists by Knorr-Cetina’s (1999) indicates the suitability of this research method within this study at CERN. These studies also provide a useful insight into the development of CERN in terms of the working practices of physicists and other academic experts and as an organisation itself. However, there is little insight within these studies as to how these changes in working practices have influenced how CERN shares information with those outside of the organisation. There is no indication as to how the changing nature of HEP research impacts communication and openness within scientific organisations. Furthermore, these studies were carried out in the early days of the digital era, before the development of numerous technologies (some developed at CERN[13]) that have since been implemented for research and communication purposes. To explore these issues, I have drawn on literature from other fields, adapting it for use at CERN.

1.3.2 CERN's Experimental Collaborations as Adhocracies

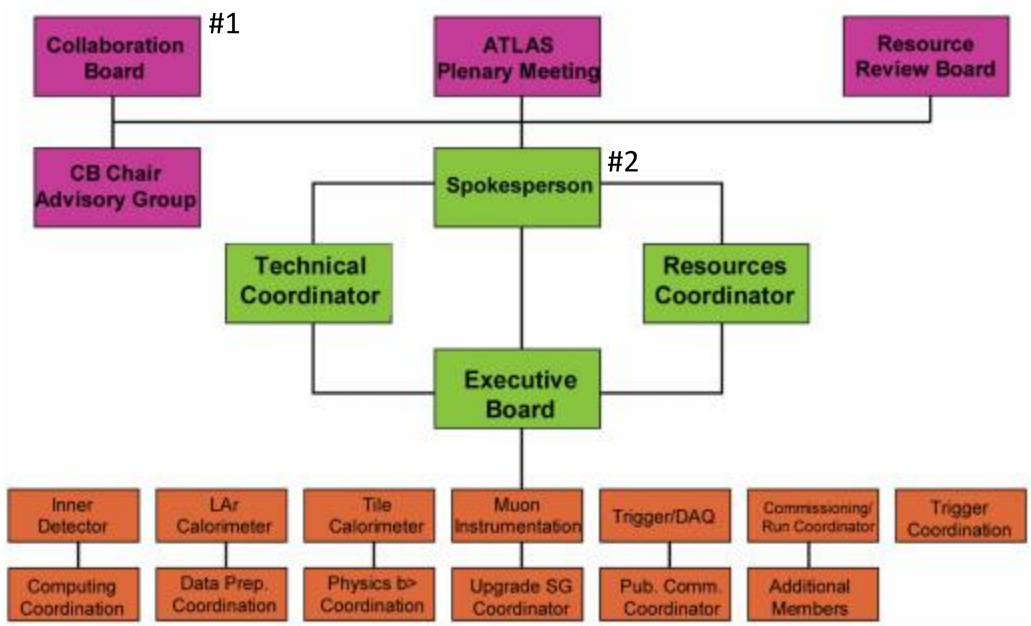
Within this thesis, Boisot *et al's.* (2011) notion of CERN's experimental collaborations as 'adhocracies' provides a useful starting point for examining CERN as an organisation. Mintzberg and McHugh's (1985) version of an adhocracy describes an organisation that works in a complex and dynamic environment, with unique and complicated outputs. These outputs require experts from many different fields to come together to form multidisciplinary teams. Coordination of such organisations is 'semi informal' with no single person able to dictate, with decision-making distributed among managers and non-managers. Such an organisation relies on its members sharing the same values as to

[13] For example, The World Wide Web (Berners-Lee, 1992).

the role of the organisation. This can be difficult with such a wide variety of cultures in numerous institutions that are geographically dispersed.

To provide an example of this adhocracy structure at CERN, Figure 1.1 represents the organisation of the ATLAS collaboration. The ATLAS collaboration alone requires 3,000 physicists from over 175 institutions across 38 countries (Boisot *et al.*, 2011). Here, teams of physicists and engineers, once again spread out across many institutions in multiple countries, are responsible for each component of the detector. As Boisot *et al.*, (2011) describe, these components will often have conflicting performance requirements, which calls for effective negotiation and trade-offs to be made between teams within the collaboration. Within the collaboration, all project managers are elected to position through the Collaboration Board (#1 Figure 1.1), with equal votes shared out across all institutions. Such a process encourages rotation of managerial positions. These managers, however, don't have traditional powers and authority to call upon. Similarly, the elected collaboration leader, the Spokesperson (#2 Figure 1.1), has no hierarchical power over the other scientists; instead their role is to delegate and guide rather than command and control. This Collaboration Board also makes decisions as to how results are published and under what conditions results/data are shared outside of the collaboration.

Figure 1.2.1: Organisation of the ATLAS Collaboration (Adapted from Boisot et al., 2011, p.454).



In terms of the relationship between ATLAS and CERN, ATLAS is not embedded directly within CERN's organisational structure (Boisot *et al.*, 2011). As such, ATLAS and the other detectors are generally seen as separate projects hosted at CERN, allowing them a great deal of independence. While independence is at times beneficial for the collaboration within the devolved entity, Boisot *et al.* (2011) argue it can often cause feelings of alienation from the wider CERN community.

What is clear within this non-hierarchical structure is how the focus on function and experimental democracy is built into the organisation. Yet, as producers of knowledge, these experiments and scientific institutions have a crucial role to play in the dissemination of scientific information. Understanding how the organisation of such scientific institutions and the nature of its research impacts on communication practices is required to understand how/what/when and why scientific information is disseminated within the public sphere (see Section 1.4). The impact of organisation and the nature of scientific research on communication is discussed further in Chapter 2, Section 2.2.

1.4 An Introduction to the Public Sphere

With the development and implementation of digital technologies within academic and professional practices, digital communications channels have opened up that serve to further connect various parties in both formal and informal manners, requiring us to rethink the way we conceptualise and frame notions of producers and consumers of information (Holliman *et al.,* 2009). One area this is especially true is in the communication and mediation of scientific information within the public sphere. This section explores the notion of the public sphere, examining the potential actors who can influence scientific debate, including the role of the mass media and scientific institutions such as CERN.

The public sphere, as outlined by Habermas (1962/1989), acts as a forum where various members of 'civic society' can come together and discuss societal issues, informing each other of relevant developments and allowing 'the public' and other relevant stakeholders to observe, review and direct these developments. Habermas (1962/1989) outlines changes from the Middle Ages to the Age of Enlightenment, whereby the public sphere developed following changes to the political structure in Europe in the 18th

Century and the collapse of feudalism. These changes to social life created a stage where educated, literate public could critically engage with social issues, meaning only a small fraction of society was involved (Habermas, (1962/1989). This ‘bourgeois public sphere’ was itself replaced when further social and economic reforms allowed takeover by the ‘modern mass society of the social welfare state’.

Along with social changes, significant technological developments played a crucial role within this public sphere. Central to these changes was the development of mass communication. The term ‘mass communication’ is defined by Thompson (1995, p.26) as:

> “The institutionalized production and generalized diffusion of symbolic goods via the fixation and transmission of information or symbolic content.”

Technical innovations, such as the development of the industrialised printing press, helped transform media industries into the large-scale commercial operations of the early 19th Century. With the industrialisation of the printing industry, the newspaper industry of the 19th and 20th Centuries became increasingly orientated to a broader public audience (Thompson, 1995). Further development of early forms of telecommunication, such as the telegraph, brought a new dimension to mass media, as information and symbolic content could be transported over vast distance with less delay. Subsequent developments of broadcast technologies increased the potential audiences mass media could reach. Habermas (1962/1989, p. 55) described this pre-digital public sphere as follows:

> "By public sphere we mean first of all a domain of our social life in which such a thing as public opinion can be formed. […] When the public is large, this kind of communication requires certain means of dissemination and influence: today [1962], newspapers and periodicals, radio and television are the media for the public sphere."

This treatment of culture as a commodity and mass media as a product designed and dispersed based on market statistics has, it is argued, reduced the public back to simple onlookers with 'expert' opinion dominating once again (Ubayasiri, 2006). Yet, the relevance of this pre-digital public sphere could be questioned as we move towards an increasingly interconnected world.

With the emergence of what is now referred to as the 'digital' or 'information age' (Holliman *et al*., 2009), digital communication channels have opened up that serve to further connect various parties in both formal and informal manners (Holliman, 2010; 2011; Chalmers, 2009; Allan, 2006). Such changes have led to what Borgman (2007) and Weller (2011) describes as 'digital scholarship', where technology is integral, ubiquitous and ambient within academic contexts. For the benefit of this thesis, digital scholarship can be applied across academic and professional practices to demonstrated how digital technologies are used not only in the research phase, but also to inform, educate, entertain and at times engage wider sections of society in increasingly novel ways. Together, this contributes to a more extended definition of scholarship (Pearce, *et al*., 2009; Weller, 2011; Scanlon, 2014). Yet, despite numerous acknowledgements of the potential benefits that digital technologies could bring as a scholarly tool (Fetterman, 1998; Windschitl, 1998), there is limited empirical evidence as to the impact technology has actually had on scholarship within the physical sciences (Greenhow *et al*., 2009). As such, this thesis aims to contribute to our current understanding of how such digital scholarly practices are actually enacted, in this case within a scientific research institution.

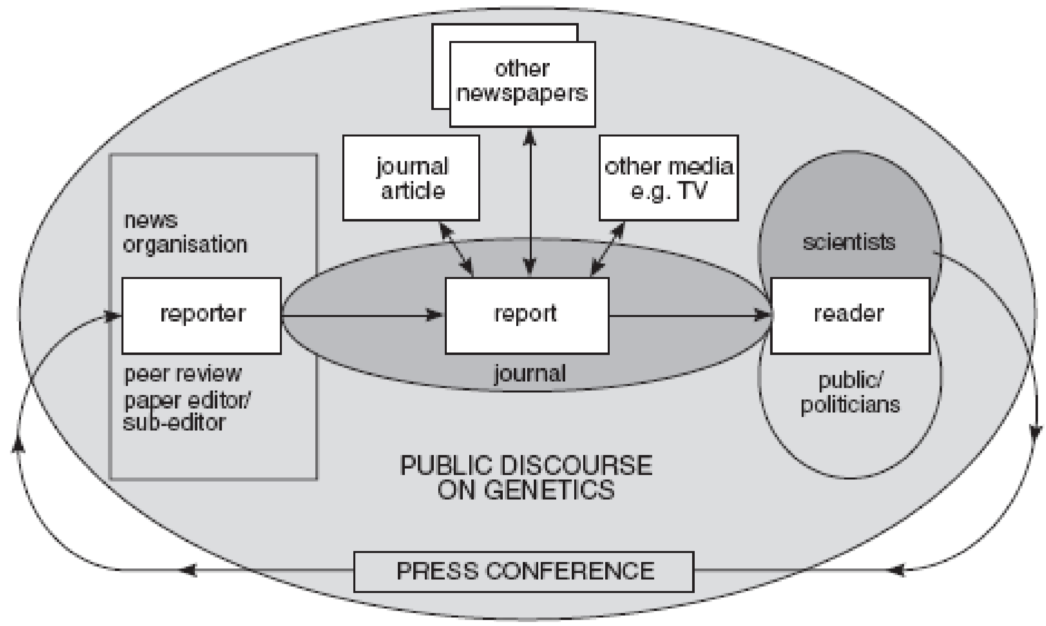
1.4.1 Exploring Mass Communication in the Public Sphere

The digital age has encouraged us to rethink the way we conceptualise notions of producers and consumers of information (Allan and Thorsen, 2009). As such, science communication researchers have to rethink the way mass communication is studied, taking into account the potential for diverse sets of actors and channels through which the framing of information within the public sphere can be influenced (Holliman, 2010).

To understand such processes of communication and mediation, models have been used to try and provide a systematic representations and provide clarity to otherwise complex events. These models have often ranged in detail and complexity. At its simplest, communication can be represented by three elements, senders, messages and receivers. Such transmission models (Shannon and Weaver, 1949) of communication provide very linear, one-way and over-simplified accounts of communication. Within these models, focus is often on the producer/sender of the message, leaving the receiver to play a passive role of simply 'taking in' the senders information. The meaning and the context of the communication is often also neglected in such models. It was assumed meaning was contained within the message rather than in the interpretation of the message. There was also no space for feedback within these one-way models of communication. In terms of science communication, the transmission model reflects aspects of the deficit model of science communication, whereby scientists send scientific information to the passively receiving public (Holliman *et al.*, 2009).

Contemporary models of communication have tried to understand and outline how communication can operate through the mass media. Leach *et al.* (2009) outline a number of communication models, varying in depth and complexity, which help to understand and analyse communication through mass media and in different settings. By combining components of the transmission and ritual models of communication, they outlined a new model, the 'media studies model', a form of which they use to demonstrate how information can be communicated to the public through news media. This model is outlined in Figure 1.2.

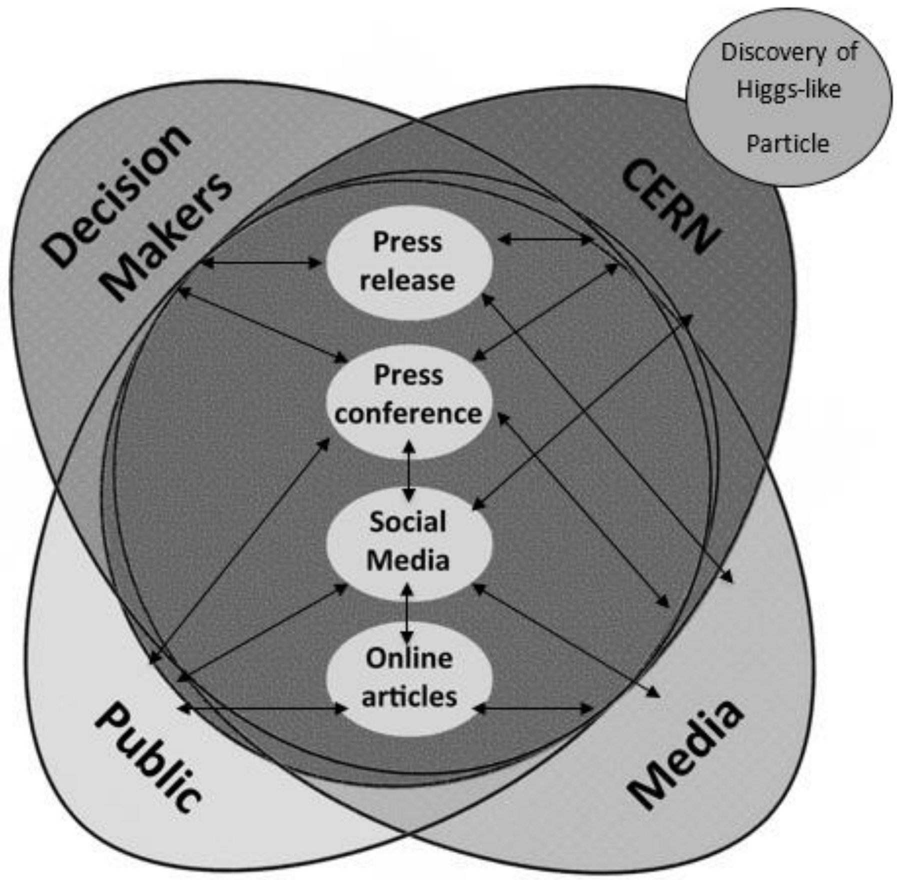
Figure 1.2.2: Communication model for reporting science (in this instance genetics) through news media (Leach et al., 2009).



While this model addresses the act of communicating scientific findings to members of the public in the form of news, it doesn't fully depict the use of digital technologies within this process. This model also doesn't show how the various actors interact within the process, often through these digital technologies. To try and address some of these issues within this study, the author has attempted to combine elements of the media studies model and Miller *et al's.* (1998) Circuit of Mass Communication with a focus on the channels through which information is disseminated.

A version of the Circuit of Mass Communication (Miller *et al.,* 1998), Figure 1.3, was adapted following early observations carried out within this study, primarily at the 4th of July 2012 Higgs update when the CERN Communications Group was working in a ‘heightened state’. Figure 1.3 represents how the various actors in this example use communications channels, including digital channels, to frame and shape debates about science in the digitally-mediated public sphere. Figure 1.3 shows how the discovery of ‘Higgs-like particle’ was disseminated through a sophisticated strategy of news management: via information subsidies (Gandy, 1982), including a Press Release (produced and circulated by the CERN Communications Group), a Press Conference (arranged and managed by the Communications Group) and through social media (CERN’s main social media account is managed by the Communications Group). The arrows demonstrate how the various actors receive information through these channels, as well at times feedback through these same channels. For example, members of the public were able to view a Web Cast of the Press Conference, and ask live questions of the speakers through social media.

Figure 1.3: Model outlining how information from the 'Higgs Update' was disseminated. (Adapted from Miller et al., 1998. See Chapter 2, Section 2.5).



While only focusing on a single event that was, in effect, at the end of the research cycle, this figure provides a starting point for understanding how scientific information can be disseminated through various channels. What can be seen is the efforts to skew the activities in the model towards the space between the scientific organisations and the media. The figure also demonstrates the complex nature of this process, with multiple channels and actors involved.

While researchers have focused on a range of media and communication professionals, such as the practices of journalists in the digital age (e.g. Allan, 2006; Allan and Thorsen 2009; Bauer *et al.,* 2007; Davis, 2008), the role of public relations professionals in society (e.g. Grunig, 1992; Miller and Dinan, 2000; Gandy, 2009) and the role of public relations in the sciences (e.g. Allan, 2009; Trench, 2008; Borchelt, 2008; Borchelt and Nielson, 2014; Weitkamp and Eidsvaag, 2014), the work of scientific public relations professionals and their role within in the dissemination of scientific information about high-energy physics remains an under researched area (Borchelt and Neilson, 2014). As Borchelt and Neilson, (2014) describe, public relations is coming to play an increasingly important role within science communication, with an increase in the institutionalisation of public relations within scientific organisations. This thesis aims to shed light on the role of such scientific public relations in the process of mediation of scientific information by studying the working practices of communication professionals at CERN, exploring the role they play in making CERN's research public in the digital age. As Thompson (1988) outlines, the process of mass communication can be separated in to three categories: Production, Content and Reception. While these categories are interconnected, their delineation allows for effective analysis of mass communication (Holliman, 2004). As such, this thesis is focused on the production element of the process of mass communication (Thompson, 1988), but within the context of the digital age.

1.5 Chapter Outline

The previous section has introduced some of the central actors and the key ideas that underpin this research. This section outlines the following chapters that present the theoretical basis, methodological approach, results and conclusion of the thesis.

Chapter 2 discusses the literature relating to the theoretical underpinnings of this study, focusing on professional and scholarly communication in a ‘digitally-mediated ecosystem’ (Holliman, 2011). Specifically, Chapter 2 focuses on the factors that impact on digital scholarly practices within scientific institutions, organisation (Section 2.2), openness (Section 2.3) and digital technology used by researchers and professionals (Section 2.4). The secondary focus of this research is surrounding Miller *et al’s.* (1998) Circuit of Mass Communication (Section 2.5), with the aim of identifying the role of public relations in this process. The chapter concludes with an outlining of the Research Question and Sub-Questions developed throughout the literature review.

Chapter 3 details the methodological approach chosen to explore digital scholarly practices and the role of public relations in the mediation of scientific information. It provides a discussion around the use of various methods, including document analysis (Section 3.2), ethnographic observations (Section 3.3) and semi-structured interviews (Section 3.4). It is argued that the exploratory nature of ethnography makes it an appropriate method for uncovering information about people and groups, such as the working practices of the Communications Group, when less is known about them (Hammersley, 2007).

Chapter 4 presents the results of a pilot study carried out at CERN involving actors with various communication and public engagement roles. The pilot study was used to map the research literature alongside strategic documentation and activities at CERN, helping to identify gaps in knowledge and areas for further study. This pilot study also helped explore the possible methodologies and methods for data collection and analysis.

Chapter 5 documents narrative accounts of the ethnographic observation carried out with the eight participants involved in the main study, following them through respective working days. These case studies provide an insight into the communication activities and the technology use of the participants, identifying the roles they play in disseminating scientific information. The tracing of the participant's use of technology throughout the observations explored how digital technologies have impacted on working and communication practices of CERN researchers and communication professionals.

Chapter 6 provides a comparative analysis, examining data from the case studies through the lenses of digital scholarship, scientific public relations and science mediation. This cross-case analysis provides an additional layer of analysis, further exploring the findings of the case studies. This cross-case analysis helps to address questions about the generalisability of the data, more so than the individual analysis, as well as strengthen the rigour and trustworthiness of the data.

Chapter 7 explores the data to address key issues surrounding the impact of organisation on communication and openness. The chapter outlines how the organisation of CERN influences communication practices across the institution and within the CERN Communications Group. Issues of openness are also explored in two ways, through digital scholarly processes of CERN researchers and professionals and their outputs. Digital scholarly processes include experimental procedures and the handling of data during the research phase, along with and the mechanisms through which information is released into the public sphere. Openness of products looks at how data is shared, particularly at the end of the research cycle and how the nature of the research carried out at CERN can make open practices problematic.

Chapter 8 reviews the key findings of the thesis, summarising the contributions to knowledge. This chapter also reviews the methodological approach and makes some recommendations for future research.

Chapter 2 Literature Review

This chapter will discuss literature relating to the theoretical underpinnings of this study, focusing on professional and scholarly communication in a 'digitally-mediated ecosystem' (Holliman, 2011).

2.1 Why Conduct a Literature Review?

As Hart (1998) describes, it is important to uncover what is known in the body of knowledge before undertaking any research, with the exploring of relevant literature helping to justify the approach, selection of methods and demonstrate that the research contributes something new to the field. Within this thesis, the main aim of the literature review was to provide the context for the project, as well as gain new perspectives and insights into the research area. Exploring the literature also helped in familiarising with the topic, especially the vocabulary, and aided in the development of an overarching Research Question and Sub-Questions (these are listed in Section 2.6). Overall, this literature review focuses on the impact digital technologies have had on the ideas being discussed, including the development of digital scholarship, digital news media and openness within the sciences. Where possible the literature review gives a chronological account of the emergence of generative ideas and practices, showing how technological developments and social, political and ethical practices have, at times, been enmeshed and at others run in parallel.

As a process, Levy and Ellis (2006) describes how an effective literature review should be carried out in a systematic way. Levy and Ellis (2006, p.182) defines the literature review process as “sequential steps to collect, know, comprehend, apply, analyse, synthesise and evaluate quality literature in order to provide a firm foundation to a topic”. Levy and Ellis (2006) suggests a three step process for carrying out an effective literature review. These steps are:

- Input: The sourcing and gathering of relevant and quality literature;
- Processing: Understanding, applying, analysing and evaluating of the literature;
- Output: Arranging and writing the literature review.

This process is not necessarily linear, as reviewing the literature is often undertaken throughout the span of a project, and the same literature may be processed on multiple occasions through different lenses.

This literature review followed similar steps as those outlined by Levy and Ellis (2006). Firstly, literature, including primary, secondary and tertiary sources, were sourced using a combination of keyword searching, backwards and forwards author searching and backwards and forwards citation/reference searching.

Keywords and key topics were chosen from the original Ph.D. proposal, which was designed to explore digital scholarship and the associated practices of those working at CERN. Terms included: ‘CERN’; ‘High-Energy Physics’; ‘digital scholarship’; ‘scientific openness'; 'big science'; and 'communication organisation'. These keywords were used as initial terms in broad searches of academic literature using electronic search engines, primarily Google Scholar. This identified a number of initial studies within the key field. From these initial sources, backward and forward author searching was carried out, followed by backward and forward reference searches, as outlined in Table 2.1. Similar searches were also carried out across multiple academic databases, including SAGE, Science Direct and the Wiley Online Library, as well as through the Open University's library, with duplicate and irrelevant pieces manually filtered out. This process led to the identification of a number of papers that provided key analytical frameworks for use within the study.

This literature review starts with an initial exploration of CERN and a critical review of a number of studies carried out within the organisation. As well as helping trace the history and development of CERN, these studies outline the shift in the nature of the scientific work carried out at CERN. This aids in the tracing of the working culture of researchers at CERN. As the likes of Whitley (1984), Fry (2004; 2006) and Fry and Talja (2007), describe, culture and the epistemology of the subject may affect the organisation of the field and the way in which technologies are adopted and used.

Table 2.1: Example of the backward/ forward literature review process used in this thesis.

Initial Search Terms	**CERN + High-Energy Physics**	**Big Science**	**Communication Organisation**	**Digital Media Practices**	**Digital Scholarship**	**Openness**
Initial Studies Identified	Knorr-Cetina (1999)	Galison *et al.* (1992)	Keyton (2005)	Paterson and Domingo (2008)	Weller (2011)	Latour (1987)
Backward Reference Search	Hermann *et al.* (1987); Pickering (1984)	Weinberg (1967)	Hoogervorst (2004)	Domingo (2005)	Boyer (1990)	Merton (1949)
Forwards Citation Search	Boisot *et al.* (2011)	Borgman (2007)	Cornelissen (2011)	Coleman (2010); Stokes (2013)	Veletsianos (2012); Grand *et al*. (2016)	Latour (1999)

The sections that follow explore a number of these issues, starting with a look at how the positioning of communication functions within an organisation can affect openness and communication practices (Section 2.2.1). This leads into a discussion about openness within science (Section 2.3), and how changes in the nature of the scientific work done at CERN through the 80's and 90's have effected internal and external openness. Section 2.3 also explores how further technological developments have since impacted more widely on openness within the sciences.

In Section 2.4, the impact of the web on scholarly and professional practices is explored, with a particular focus on its impact on media professionals and the role of public relations within science communication. Section 2.5 rounds off with a look at the roles of various actors in the mediation of scientific information, as well as the process through which the communication of scientific information occurs. Finally, the chapter concludes with a summary of the literature review and the outlining of the Research Question and Sub-Questions as developed from the review.

2.2 The Organisation of CERN: Communication Structure

This section follows on from Knorr-Cetina's (1999) description of the structure and organisation of CERN and the experiments (Chapter 1, Section 1.3.1), with their increasing size and complexity, to explore their communications architecture and the positioning of the Communications Group within this organisation. This provides an insight into how the positioning of communicative functions within an organisation influences communication practices and openness, allowing a researcher to identify and analyse how the organisation of CERN has impacted on its communication functions.

Complementing the earlier description of CERN as an 'Adhocracy' (Chapter 1, Section 1.3.2), Knorr-Cetina (1999) described the organisation of CERN and the experiments as a 'post-traditional communitarian structure', with distributed responsibility and authority. With this, no one person or even group can know everything there is to know about the experiments. While this can facilitate verification of findings between multiple experiments, such a structure can produce numerous difficulties when it comes to internal and external communication.

In order to understand the communicative behaviour of an organisation, Keyton (2005) developed a pyramid model of organisational culture to try and give some structure to its complex elements. Keyton's (2005) model is made up of four levels, the *basic*, *process*, *subjective* and *satisfaction* elements. Keyton (2005) argues that while these levels may vary between organisations, its structure of cultural elements should exist in any organisation. At the first level are the 'basic' communication elements, the communicative artefacts at the centre of the organisation, such as job descriptions and the organisations mission statement. Keyton's (2005) second level, the 'process' element, is the means by which messages and information is shared through formal and informal channels in upward, downward and horizontal directions. This level contributes to employees' understanding of the function of the organisation and their role within. This is particularly relevant within this study, with analysis at this level helping to identify how members of CERN Communications Group see their roles, both within the group and within CERN more broadly. This also helps to identify where the Communications Group sits within CERN's communications architecture. The third level, the 'subjective' element, is influenced by the basic and process elements and refers to inter-relationships throughout the organisation, such as levels of trust, cohesion and perceived value to the organisation. All together, these three elements come to form the 'satisfaction' elements of the organisations communication culture, which focuses on "internal and external communication and their integration" (Keyton, 2005, p.178).

As Keyton (2005) explains, communication within an organisation can be expressed in many ways and through multiple channels, including human interaction, information technologies or multimedia and print[14]. According to Hoogervorst (2004), the structure, culture and systems of an organisation have a direct effect on the way its members communicate, both internally and externally (the latter within the public sphere). Porter-O'Grady (1997) also argues that the effectiveness of an organisation depends on the level of partnership, ownership, integration and inclusion, which is achieved through various measures, including effective dialogue. Furthermore, Hoogervorst (2004) argues that the structure of an organisation needs to complement its goals for them to be realised. As a result, the various structures within the organisation should be consistent so a united vision, mission and message can be achieved. However, communication can be ineffective if certain barriers such as lack of collectivism, cultural differences, under-staffing and isolation of managers exist within an organisation. Hence, these issues will be explored when looking into the factors effecting the ability of the CERN Communications Group to carry out their functions.

As Lindlof and Taylor (2002) describe, effective communication within an organisation relies on the ability of its members to identify and resolve issues and develop cultures that successfully balance tensions between individual and organisational goals. With this

[14] Keyton (2005) recommends the use of ethnographic techniques, including observations and interviews to explore such channels. Such methods were used within this study (See Chapter 3).

in mind, Keyton's (2005) four elements may only apply to traditional staff (full-time employees), while the needs of non-standard workers (part-time or temporary contract staff) may not be met at the process level. This could well be the case at an organisation such as CERN where experimental physicists working on the various collaborations are not directly employed by CERN, rather they are titled 'CERN Users' who carry out their research using CERN's facilities while being financed by their home institutes. Those employed directly by CERN are titled 'CERN staff', who are primarily technical, engineering, office and admin staff (such as those in the CERN Communications Group), as well as some research physicists.

With the process element underpinning the satisfaction element, breakdown at this process level for 'CERN Users' could negatively impact how valued and included they feel within the organisation. This research intends to explore and help evidence this issue, examining how CERN Users see themselves within the wider CERN community, exploring how the separations between Users and Staff impact on horizontal and vertical communication flows. The effect on external communication will also be explored, as a lack of information sharing between physicists (Users) and the Communications Group (Staff) could reduce that amount of information being released into the public sphere.

2.2.1 Centralised vs Decentralised Communication

As Hoovergrast (2004) describes, the structure and culture of an organisation will influence certain aspects of communication and openness, including internal openness.

Yet, as Knorr-Cetina (1999) outlined, CERN does not have the same lines of control as many other large, complex organisations due to the highly specialised nature of the teams working on various technical aspects of the experiments (see also Chapter 1). Such technical demands and specialisation means it is difficult to consistently exert top-down control, as no one person is able to make such decisions on that scale. Additionally, the distributed network of potential communicators makes it difficult to coordinate communications. This doesn't mean however, that CERN or the collaborations become some kind of democracy. Knorr-Cetina (1999) instead describes CERN as a commune, where individual scientists sacrifice their identity and work towards a collective goal, with 'organised competition' between collaborations and subgroups helping the collaborations thrive. Such organisation can, however, cause issues over internal communication and openness, with concealment between experiments and the wider organisation making it difficult to communicate results.

One means by which organisations can attempt to create a consistent message is through the centralising of communication activities. As Cornelissen (2011) describes, there are multiple benefits to uniting communication activities and disciplines within a large, complex organisation. There is an economic rationale as it minimises the necessity and cost associated with cross-department interaction, while integration can also help enhance the functional expertise and skill sets of media professionals within departments. Goodman (1998) explains how a centralised Communications Group within an organisation is key to meeting strategic goals by providing consistent and coherent messages. Goodman (1998) also argues that communicating with various publics achieves this consistency when it is done with a single voice, with a clear message and mission statement also helping employs gain a better understanding of what an organisation stands for. Overall, Cornelissen (2011) argues that integration increases the accountability of the communication function in many organisations and make them better able to provide strategic direction to all of their communication. In reality, however, this is hard to achieve, especially in an organisation like CERN with distributed governance and various departments and experiments who have specific audiences, messages and intentions. Centralising communication also relies on a ‘gatekeeper’, a person or group that shape information about events and decide how they are transmitted and framed, which in itself can potentially limit the voices heard and prevent innovative communication methods.

In contrast, an organisation with a decentralised communication structure spreads these functions across various departments or units. Such structuring can allow more participants from broader backgrounds to be involved in communication, increasing feelings of belonging and reducing feelings of alienation associated with centralised, ‘command and control’ models of communication (Daft, 2012). Decentralised communication can also provide greater flexibility, allowing for fast and timely response to issues that may arise, often bypassing the need for gatekeepers and allowing direct contact with experts. However, decentralisation makes it harder to coordinate communication at a strategic level, with numerous lines of communication needed between the various units. Duplication of material is also more likely, which can waste valuable resources.

2.2.2 Summary

While the work outlined in this section provides a broad insight into how organisation can effect communication, there is less empirical evidence as to how this actually occurs in practice, particularly within large, high-energy physics institutions. As a result, there is a lack of empirical work as to what a Communications Group is, what its functions should be, or the role of its members. In trying to gain an insight into how CERN's research becomes public, it is important to establish the function of the Communications Group and how the organisation of CERN impacts on their ability to carry out these functions. This includes the relationship between the Communications Group and the various other actors involved in communications. Along with the overarching Research Question, this makes up the first series of Sub-Questions surrounding the organisation of CERN:

How has the concept of openness, and the emergence of digital technologies, influenced the organisational culture of CERN and the practices of CERN researchers and communications professionals?

- *How does CERN's Adhocracy organisation impact on communication practices and openness?*

- *How does CERN's communications architecture impact on communication practices and openness?*
- *Where does the CERN Communications Group sit within the organisation?*

2.3 Openness and the Nature of Science

This section explores ideas about the nature of science in relation to communication and openness, with particular reference to the effects the digital age has had on the scientific methods at CERN. This helps provide an initial understanding of how the nature of the scientific work carried out at CERN can affect the way in which they communicate, both internally and externally, and certain aspects of openness.

In order to understand the mechanism by which scientific knowledge is created, Merton (1942/1973) studied this process and identified four 'institutional imperatives' that he believed scientists followed. These are summarised below as:

- *Communism[15]:* Property rights only extend to the naming of scientific discoveries. All other intellectual property rights are given up in exchange for recognition and esteem;
- *Universalism*. Scientific discoveries must conform with previously confirmed knowledge and are evaluated in terms of universal or impersonal criteria.

[15] Referred to as *communalism* in later versions (Merton, 1942/1973).

Scientific truths should be observable or testable regardless of national, political, or religious boundaries;

- *Disinterestedness*. Scientists must appear to act in ways that are selfless in their pursuit of claims to truth, thereby ensuring integrity in the research process and reducing fraud;
- *Organized Skepticism*[16]. Scientists are critical: All ideas must be tested and are subject to rigorous structured community scrutiny.

(Merton 1942, cited in Storer 1973, pp. 267- 278)

Later, Merton (1949) introduced the concept of 'obliteration by incorporation' to describe sharing amongst the sciences, whereby a concept or theory becomes so popularised that its creator is forgotten, no longer gets cited, and the idea is considered common knowledge. In essence, the process behind the creation or discovery is forgotten. This is perhaps best outlined in the world of computing, with O'Shea *et al's.* (1981) metaphor for an interactive computer system as a 'black box inside a glass box', whereby the complex underlying process is hidden (black boxed) with only a simplified version (glass box) seen by users. This notion was expanded by Latour (1987), describing scientific progress as the creation of such 'black boxes'. According to Latour (1987), black

[16] Split into two in later versions (Merton, 1942/1973).

boxes are created when new knowledge is established and the uncertainty of the process behind the discovery is removed to an outside observer. For Latour (1987), this is essential for scientific progress, as it allows for the compartmentalising of scientific knowledge on which new knowledge can be built. As such, within each black box are numerous other boxes. ‘Black boxing’, therefore, can create issues over openness, transparency and accessibility of results and scientific information, as it limits ones ability to question what is hidden within the box. Trying to open a black box to question results is often difficult, requiring specific skills and expertise to scrutinise what is inside. While difficult enough for scientists, this is a particularly important issue when it comes to science and publics.

Latour (1999) contrasts this idea of black boxed, 'ready-made science', with the notion of 'science in the making'. Here, Latour (1999) describes how experiencing science and technology in action enables you to see inside the box 'before the box closes'. With this, science can be seen and understood as a social process of competition and collaboration, critique and consensus, produced in a specific social context. Much of the work carried out at CERN, for example, is ‘science in the making’, promoting the nature of collaboration and competition in driving the science forward. Over time and through this process, 'science in the making' can become a type of 'ready-made science' that enables people to see the process behind the creation or discovery once more. In this respect, openness is not just about the products of scientific research, but also open process that lets us see how the boxes are made.

Overall, the notion of black boxing is in stark contrast to Merton’s (1949) 'universalism' element, whereby anyone, in principle, should be able to check if scientific knowledge is valid. Indeed, as Collins (1985) describes, this notion of openness and especially replication of scientific results is not as straightforward as Merton (1949) implies. This is apparent at CERN, where the nature of the work carried out makes openness difficult. With many of the experiments searching for similar things, each collaboration does not discuss any findings until they have been fully confirmed, in effect, producing a temporary black box. This desire to keep results within collaborations until they have been confirmed is frequent within HEP. Knorr-Cetina (1999) talks of the importance of collaboration in HEP experiments to not only build and run complex instruments, but to also analyse individually achieved results in something akin to an internal peer review process. Such results may well be of significance to other members of the collaboration who could use them in further calculations. In this respect, individually achieved results need to be returned to the collaboration before going to the community at large in order to benefit their own experiment. In turn, the need for such procedures and the guidelines that enforce them effectively puts a timestamp on openness for the end of the experimental procedure. As such, even in an ‘adhocracy’ (Mintzberg and McHugh, 1985), there is some form of ‘command and control’ within the collaborations. While such procedures are crucial in terms of preventing experimental bias, it can make communicating results in different forms and to different audiences difficult.

Galison *et al.* (1992) also argue for the importance of this internal peer review process by questioning who could actually review any papers put out by High-Energy Physics collaboration. Wagner (2006) summarises a number of limitations of the traditional external peer review process. Here, Wagner (2006) outlines the cost of peer review in terms of time and resources required, indicating the inefficiency of the process. The reliability of this process is also questioned, with reviews not always commenting on all the issues within the paper, possibly because a lack of expertise on the side of the reviewer. In respect to HEP, Galison (2010, p.484) argues that you eventually "reach a stage where the only people qualified to truly review the work are within the collaboration".

What needs to be taken into account then is the balance between a need for openness and transparency and the institutionally justified need for concealment (Jasanoff, 2006). As Merton (1973) describes, science could not be science without the 'organised scepticism' of the peer criticism process. The benefits of such a process are made clearer when contrasted with the concept of 'black-boxing', whereby scientific theories and/or results are consolidated into entities that are difficult to challenge or revisit once they have been established (Jasanoff, 2006). Understanding the factors that influence openness is key to understanding how it is enacted within an organisation and how this impacts on the communication of scientific information.

This thesis will explore how the nature of the work carried out at CERN impacts on the function of the Communications Group. For example, given the complexity of the work carried out, do the members of the Communications Group need physics backgrounds in order to interpret results in order to 'translate' it for non-specialised audiences? If they do, does this compromise any impartiality required of the Communications Group? These form the basis of the next set of Sub-Questions:

- *How does the nature of the work carried out at CERN impact on the function of the Communications Group?*
- *Do members of the Communications Group require scientific backgrounds to carry out their functions?*
    - *How does their background effect their working practices?*

2.3.1 Openness, Technology and Big Science

In the early 60's, when researchers at the newly-created CERN were still learning how best to use the equipment, CERN was, rather simplistically, referred to as a "big science photocopier" (Galison, 1992, p.97) as they reproduced (sometimes improving) work done elsewhere. The increase in size and diversity of the collaborations resulting from the shift in the nature of the work carried out at CERN truly established the experiments as big science projects. The characterisation here of big science goes further than just the size of the experiments and the money they cost. Smith and Tatarewicz (1994) more global perspective on big science, points towards the interplay between the various technical and non-technical groups, describing big science projects as a number of technical, institutional and social networks.

With the shift in technology and working practices, as described in Chapter 1, Section 1.3.1, came an increase in data produced by the experiments at CERN. As Borgman (2010) points out, with technical and communication infrastructures developing, the ability to collect and handle large data sets has enabled academics to conduct new research in novel ways. The use of digital technologies to create large-scale experiments and analyse masses of data created the need for extensive collaborations between scientists, engineers and computer scientists.

While big science projects create a vast amount of data, primarily digital data, they also have the resources to construct repositories to address the 'data deluge'. The creation of 'cyberinfrastructures' within big science has been the key to managing the data deluge (Borgman, 2007). These infrastructures provide distributed access to equipment, computational resources and digital data stores, facilitating the collaboration required for big science projects (Borgman, 2007). But, as Borgman (2012) notes, to benefit from this increase in data, researchers must be prepared to share it in appropriate ways, ways that make it understandable and accessible to many different groups. As experiments themselves cross into public space, requiring increased public funding and impacting on public life, science has become involved in local and international levels of debate. Key here is both the accessibility of data and the mediation between researchers, publics and various stakeholders (Weller, 2011). Although, access to scientific data and knowledge held on digital platforms can require expensive hardware, access to specific networks and require specific skills to manoeuvre, a lack of which can limit who can access scientific information (Holliman and Curtis, 2015). In this respect, data may be open but difficult to access and not genuinely engaging.

Digital technologies have not only increased the amount of data that can be collected, they also bring the potential to share it more easily between groups and make it publicly available. But, as Hanson *et al.* (2011) point out, while many areas of science recognise the importance of making data widely available, potentially increasing openness and transparency, the release of data is influenced by the cultural practices of the specific fields and attitudes towards open sharing.

Moves towards openness have gained a great deal of momentum in the last decade, particularly in regards to open access and open data. When it comes to open access, digital technologies have made it possible to end the limited access to journal articles by researchers and publics (Weller, 2011). With research institutions only able to afford a fraction of the traditional subscription journals, open access has the potential to minimise this issue through open access journals and repositories. Since the early 2000’s, funders and/or research institutions have been increasingly issuing open access mandates for their researchers, encouraging self-archiving of peer-reviewed papers within institutional repositories. This is often called Green Open Access (OA).

Alternatively, open access can be provided by academic publishers through peer reviewed journal publications, with payments made for the paper to be published rather than accessed. This is known as Gold OA or the 'author pays' model. According to Harnad (2015), around 60% of subscription journals (i.e. those who are not fully open access already) allow immediate self-archiving by their authors. The remaining 40% of subscription journals impose some form of embargo on open access, preventing authors from self-archiving for a period of time.

Arguably, the UK have been leaders in the open access movement (Harnad, 2013), particularly when it comes to Green OA (Gartner, 2009). However, following the Finch Report[17] in 2012, commissioned by the UK Government, instead of building on this Green OA, the UK has switched its focus to Gold OA, with authors (read institutions in the main) paying publishers to become open access, to a critical response (Harnad, 2013; Weller, 2013; Mabe and Price, 2012; Pinfield *et al.*, 2015). This 'author pays' model was further endorsed by the Research Councils UK (RCUK) with the awards of block grants to 'research active' UK universities, and the encouragement to journals to provide a Gold OA option for papers coming from RCUK funded research[18] (RCUK, 2013; Baruch *et al.,* 2013).

[17] Finch Report, https://www.acu.ac.uk/research-information-network/finch-report, last accessed 12.07.2016.

[18] RCUK also recommend the use of Green OA.

In many respects, physics has lead the way when it comes to OA in the sciences, where un-embargoed Green OA has been practiced for over 20 years (Harnad, 2015). Close to 100% of physics papers are self-archived within the external repository Arxiv[19]. Within CERN and HEP specifically, in 2012, the Sponsoring Consortium for Open Access Publishing in Particle Physics[20] (SCOAP3) helped convert significant HEP journals to Gold OA, with the consortium paying publishers to switch to OA, minimising the cost to authors themselves (Van Noorden, 2012).

Along with open access, open data is another branch of the openness movement that has gained momentum in recent years. Originating in academia, particularly in the sciences (Murray-Rust, 2008), ideas around openness of data have been adopted in the political world in order to make governmental data more open and transparent, most notably Obama's open government initiative (Obama, 2009) and the G8 Open Data Charter[21]. Open data has also become an important topic for discussion at CERN, with the Data Preservation in Long Term Analysis in High Energy Physics Working Group examining how data from the LHC is being stored and shared (Gibney, 2013). Ensuring data from the LHC is appropriately stored, open and easily accessible could allow new

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[19] Arxiv Pre-print server, https://arxiv.org/, last accessed 12.07.2016.

[20] Sponsoring Consortium for Open Access Publishing in Particle Physics, https://scoap3.org/, last accessed 12.07.2016.

[21] G8 Open Data Charter and Technical Annex, https://www.gov.uk/government/publications/open-data-charter/g8-open-data-charter-and-technical-annex, 12.07.2016.

theories to be developed and tested while providing a reference points for future experiments.

In exploring the practice of data sharing in scientific scholarship, Borgman (2007, p.196) suggests four reasons why scientists may not reveal their data:

- Insufficient perceived reward, such as promotion or subsequent citation;
- Effort in documenting;
- Concerns for priority, including control of results and sources;
- Intellectual property issues.

Within this, Borgman (2007) suggests a feeling of ownership over data can give bargaining powers to scientists who can use these against those who want to see the data. Yet, as Borgman (2007) questions, how does ownership of data work when a diverse collaboration of funders, scientists etc. have contributed to it? This is of particular importance to big science projects such as the LHC at CERN. With such big science projects come added difficulties when it comes to openness and replicability. While small scale, cheaper experiments may be replicated, this is not as easy with something the size and cost of the LHC. To overcome this, data from larger projects needs to be stored appropriately in order for it to be analysed and, if needed, re-used down the line. This can be difficult when the data is so specific and written in a way that only those on the experiments could understand. This is often the case, as Borgman

(2007) describes, where the infrastructure needed to make new, novel forms of digital data available and easily accessible is often lacking in certain fields. This means the release and sharing of data is not consistent across all disciplines and by all researchers and nor is it ever likely to be. Wallis *et al.* (2013) demonstrated how little data is actually shared beyond the initial research teams. Similarly, Grand *et al.* (2012) explains how scientific information is often only made available once results have been fully gathered and analysed, leaving the process behind the results remaining relatively obscure. This is currently the case at CERN, where research is primarily shared through Open Access Publications (Harnad, 2015), with little to no raw data released. The reason and impact of this lack of openness of raw data at CERN will therefore be explored with CERN researchers.

Overall, research into the impacts digital technologies have had on openness has proved conflicting. While digital technologies provide the potential for scientific openness, resistance can be met, because they are *social* technologies when in use. Procter *et al*. (2010) show how many researchers still prefer to use formal publishing in print and e-journals even if other digital channels are available, as formal channels provide greater recognition from peers, which can have significant benefits. Only 5% of those researchers studied were shown to publish any part of their research progress or final data through Web 2.0 technologies. While certain digital technologies (web pages, e-mail digital libraries etc.) have become well established in many contexts (Bittner and Muller, 2011; Nicholas *et al.,* 2011), studies by Harely *et al.* (2010), Procter *et al.* (2010), Schonfeld and Housewright (2010) and Pearce (2010) have shown limited use of 'new' digital communications channels in research activities. Similarly, Chalmers (2009) describes how despite calls to improve transparency and social involvement in medical research, public access to full results of clinical trials remains limited due to resistance by some researchers and research sponsors.

While results may be conflicting, what can be argued is that the adoption and use of technologies will vary depending on the culture of the discipline, the norms and conventions at the local level, the institutional context and academic identity (Grand *et al*., 2016). Understanding CERN and the various communication actors at such levels is therefore vital in understanding how and why certain technologies have been adopted or not by those working at CERN, and how this effects openness. Yet, as described earlier, the question surrounding the use of digital technologies is not just about openness, but about the level of engagement as well. With the complex and specialised nature of the work carried out, the Communications Group may require additional mediators (i.e. external media professionals) to further disseminate information. This forms the basis of the next Sub-Questions:

- How does the nature of the work carried out at CERN impact on openness?
- How have digital technologies impacted on the communication practices of researchers and communication professionals working at CERN?

2.4 The Internet, Web 1.0, 2.0 and 3.0: Impacts on Scholarly and Professional Practices

Two technical innovations that have undoubtedly impacted not only on science and academia but society as a whole have been the Internet and the World Wide Web. This section looks into some of these developments and the impact they have had on scholarly and professional practice. The focus will be on the working practices of scholars (Weller, 2011) and media professionals (Fahy and Nisbet, 2011) in the digital age, in order to help trace the function and working practices members of the CERN Communications Group.

The Internet is the networking infrastructure that connects computers and allows them to communicate (Leiner, 2009). The Web is one of the services that runs on the Internet that allows access to it. The web was originally created at CERN to meet the demand for information sharing between HEP scientists and engineers across the world (Gillies and Cailliau, 2000). Put simply, the Internet connects computers, the web connects people.

Within academia, the Internet has been touted for years for its ability to be used as an educational tool through web-based learning, student-teacher communication and function as an information repository (Greenhow *et al.*, 2009). As early as 1998, Fetterman (1998) mentioned the potential impacts email, web browsing and video-conferencing technologies could have in research and scholarship. Scanlon (2013) describes how digital technologies provide opportunities to extend research and teaching practices through formal and informal publications, while new forms of open access and open peer review have implications for openness and transparency within academia. This combining of digital technologies with academic practices brings forward a new form of scholarship, digital scholarship (Borgman, 2007; Weller, 2011). In defining digital scholarship, Weller (2011, p.50) brings together the threads from Section 1.4.1 with the points made here to argue that this is a cultural phenomenon with the potential to influence all aspects of academic life:

> "Digital Scholarship is more than just using information and communications technologies to research, teach and collaborate, but it is embracing the open values, ideology and potential of technologies born of peer-to-peer networking and wiki ways of working in order to benefit both the academy and society."

Pearce (2011) and Weller (2011) also point out the potential for digital scholarship to not only benefit academia, but to also benefit society through this increase in openness and dialogue through such things as citizen science initiatives (Holliman and Curtis, 2015).

With access to the Internet increasing dramatically over the past 20 years, so too has the nature of the Web. Originally developed at CERN (Berners-Lee, 1992) the Web was seen to provide a similar function to conventional educational resources, e.g. as an information source and communications tool, and was organised in a similar way, with experts creating and presenting knowledge for dissemination. This 'Web 1.0', as it became known, eventually morphed into 'Web 2.0', which was characterised by its increased collaborative and participatory media, features missing from its predecessor (Solomon and Schrum, 2007; Holliman, 2010). Web 2.0 opened up new connections between users and content and allowed the transforming of personal knowledge into shared knowledge. Ultimately, it was hoped Web 2.0 could improve the accessibility of knowledge and increase the number of users who could be involved in the creation of knowledge. What has followed from Web 2.0 in recent years has been the concept of Web 3.0. The idea behind Web 3.0 is to try and find more efficient ways to discover, manage, organise, analyse and reuse user generated data, creating new meaning from it (Hendler, 2009; Holliman, 2010). Web 3.0 is also known as the 'semantic' or 'social semantic' web, an idea originating with Tim Berners-Lee (Shadbolt *et al.*, 2006). One of the key ideas behind the semantic web is to have information readable by computers, allowing them to create new meaning from data. Overall, Web 3.0 aims to combine semantic technologies with the social networking we see in Web 2.0 technologies (Aghaei *et al.*, 2012), a culture in which large scale, big science projects, with a distributed network of researchers, such as CERN's, operate.

2.4.1 Social Technologies in Academic Use

Many studies into developments in digital scholarly practices use Boyer's (1990) definition of scholarship, based around the connections and interactions of four functions: *Discovery, Integration, Application and Teaching*; and how embracing open values can extend these practices in the digital age (Scanlon, 2013). In Boyer's (1990) first function, the digital age brings with it opportunities for new knowledge creation/discovery through increased accessibility to research and data[22], as well as unique opportunities to collaborate. With many areas of the sciences, particularly HEP physics, relying on collaboration between large groups (Galison and Hevley, 1992), digital technologies can allow for greater collaboration (Scanlon, 2014). Wiki applications, such as TWikis[23], are being regularly used as collaborative research tools in biosciences (Waldrop, 2008). Linked to Boyer's (1990) integration and application functions, digital technologies can also facilitate interdisciplinary collaboration, connecting disciplines in unique ways. This has been described as 'Networked Participatory Scholarship'[24] (Veletsianos and Kimmons, 2011) where technologies such as social networking services, blogs, video sharing can be used in all aspects of the scholarly process. For example, Veletsianos (2012) found academics use the social networking site Twitter™ to connect students with professional communities outside of the classroom and share resources. This allows for distributed knowledge and expertise to be brought together, encouraging participation and engagement. Veletsianos (2012) noted, however, that participation would vary depending on intended audiences and the goals and motivations of the academic. Exploring the use of social technologies at CERN as tools to interact and engage with various communities, both academic and non-academic, provides a useful

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[22] For a discussion on open access publishing and data see Chapter 2, Section 2.3.1.

[23] Twiki, http://twiki.org/, last accessed 12.07.2016.

[24] For an example of Networked Participatory Scholarship, see Section 5.1.2.

opportunity to realise how digital scholarship are actually enacted within such an institution.

Finally, within Boyer's (1990) teaching function, the creation of digital resources allows teaching materials to be easily reproduced and spread globally (Weller, 2012). Open Educational Practices (OEP's) and Open Education Resources (OER's) have the potential to revolutionise education, particularly higher education (Katz *et al.*, 2010), and bridge social, educational and geographic barriers (Olcott, 2012). OER includes a broad range of individual resources, text books and software, as well as full courses, such as Massive Open Online Courses (MOOC's). MOOC's have gained increasing attention since 2012 with the creation of edX[25] and Coursera[26] in the United States, and FutureLearn[27] in the UK in 2013. Courses available span most disciplines, including the physical sciences (Rodriguez, 2013), with one of the earliest introductory physics MOOC's available on edX in 2013 (Rayyan *et al.*, 2013). Although, while there is potential for MOOC's and other OER's to significantly change the higher education landscape, these new resources and practices do, however, require learners and educators to develop new digital skills to

[25] Edx, https://www.edx.org/, last accessed 12.07.2016.

[26] Coursea, https://www.coursera.org/, last accessed 12.07.2016.

[27] Futurelearn, https://www.futurelearn.com/, last accessed 12.07.2016.

create, access and use resources effectively (Atenas *et al.,* 2014). There are also issues around measures of quality and sustainability when it comes to MOOC's (Weller, 2014).

While Boyer's (1990) provides a useful way to delineate functions of scholarship, it does have its criticisms. Boyer's (1990) work was based on the analysis of American Universities, which, as Johnston (1998) points out, means the context in which his framework was formed may prevent its application in other contexts with different political or social values. Furthermore, much of Boyer's (1990) work focuses on the scholar as an individual in the pre-digital age, which fails to take into account scholarship in an ever increasing collaborative and networked, academic world.

Providing a more detailed account of scholarly activities undertaken by various disciplines in the digital age, Palmer *et al.* (2009) examined the practices of scholars during their research and how they could benefit from the adoption of digital technologies. Palmer *et al.* (2009) outlined five key activities: *Searching, Collecting, Reading, Writing and Collaborating;* which were further refined to give a list of 20 'scholarly primitives'. Of these 20, the most applicable across all disciplines were shown to be:

1. Chaining – The use of citations, references, bibliographies to help identify the most important works on a topic and examine the links between them
2. Accessing – Having data readily available

3. Assessing – Judging a source or data for its relevance and usefulness
4. Disseminating – The Presenting/sharing of knowledge
5. Networking – Establishing relationships with colleagues and associates

(Palmer *et al*., 2009, p44)

Co-authoring, *coordinating*, *networkin*g, *monitoring* and *data sharing* were shown to be of particular importance to the sciences. The identification and defining of these activities provide a useful basis when attempting to explore the working practices of scholarly communities, not just individual scholars. As a result, this activity-based framework became integral to my identification and tracing of scholarly activities carried out by researchers at CERN.

2.4.2 Types of Networked Participatory Scholars

In order to understand how an individual's use of technology impacts their communication, working and engagement practices, Grand *et al.* (2016) developed a typology of digitally engaged researcher that broadly categorises users based on their use of technology during these practices. These include the 'highly-wired', 'dabbler' and the 'unconvinced', represented in Table 2.2.

Table 2.2: Digital engagement types (taken from Grand et al., 2016, p.14)

Type	**Online persona**	**Engagement**	**Digital tool use**	**Digital practice**
'Highly-wired'	Well-developed	Highly collaborative; works with multiple stakeholders	Multiple tools Strategic Sustains partnerships	Originally personal but extended to projects
'Dabbler'	At an early stage of development; patchy or unfocussed	Collaborative	Some experience with multiple tools Strategic use at early stage Draws on colleagues' skills	Originates in project demands but extends to personal
'Unconvinced'	Non-existent or meeting minimal institutional demands	Minimal	Uses communication tools e.g. email	Low level or non-existent

However, these categories are not designed to represent fixed individual ideals, rather they are ideal types. Individuals can cross categories throughout their career, depending on their role and the specific tasks they are undertaking. Mixes of such individuals, with varying digital capabilities, will also be found to various degrees within communities.

Using Grand *et al's.* (2016) typology of digitally engaged researchers, the tracing of the participant's use of technologies for communication, working and engagement practices can be done, identifying the types of digitally engaged individuals. This would help provide an insight into the digital mediated ecosystem of the Communications Group. This is explored through the next set of Sub-Questions:

- *How are digital technologies used for engagement purposes by CERN researchers and professionals?*
- *What factors influence digital technology use by researchers and professionals at CERN?*

2.4.3 Digital News Media: A Forum for Debate?

The question of who is an 'expert' and how 'expertise' is deployed in the sciences takes an interesting turn when we think about participatory scholarship/multi-disciplinary research. Where participation by varied types of expertise is possible, many institutions need to ask themselves which types of expertise they want to include in the production, analyses and implementation of scientific knowledge? How could this be done and what are the desired and unintended outcomes? How do you balance 'expert' knowledge with that of publics, stakeholders and user communities and how does this relationship change over time? This requires particular attention when it comes to a democratic public sphere (Bäckstrand, 2003). Problems arise surrounding the framing of scientific issues in the public sphere. In the past, and to some extent the present, scientific issues have often been framed as matters for scientists or political decision makers (Bäckstrand, 2003), neglecting public views and opinions. It could be argued that public relations units, such as CERN’s Communications Groups, connect research institutions to this forum, providing information as to what is going on within scientific institutions.

The potential of the Internet to connect individuals has led to the belief that digital technologies could impact on many areas of life (Ubayasiri, 2006), in effect providing a 'digital public sphere’, a forum where people can express opinion, debate topics and develop and contribute to knowledge production (Holliman, 2011). Different forums have been realised within the public sphere, which can be categorised by certain factors such as structure, the degree of openness and impact. One of the forums for debate and representation within the public sphere is news media and the debates that emerge.

With the development of Web 2.0 technologies came the possibility that these technologies could reduce the isolating effects associated with news media. Many proponents of the Internet and Web 2.0 technologies see their potential to include more participants, such as ‘citizen journalism’ (Allan, 2006), provide a forum for voices and opinions previously unheard and in turn create a more engaged and democratic society (Dahlgren, 2005). For example, Holliman (2011) showed how traditional practices of scientific publications were opened up for public examination by social network users who used 'scientific rhetoric and sophisticated communication strategies' to challenge the expertise of leading climate scientists. This helped create conditions where the issues raised through the 'climategate' episode could be subject to public debate through digital communications channels (e.g. blogs) and digital media organisations.

Such an example, it could be seen, demonstrates the ability of the Internet and Web 2.0/3.0 technologies to provide alternative routes to influence debates in the public sphere. The combining of the technological with the social in such a way within digital technologies has helped create what can be seen as a digitally-mediated public sphere. Advocates and interested parties can use these digital tools, technologies and routes to shape scientific discourse. Yet, the extent to which this has occurs is yet to be realised (Allan, 2007). Within scientific institutions, for example, the use of such technologies for such purposes is not simple.

As Macnamara (2012) describes, there is often a conflict between this philosophy of openness afforded by Web 2.0/3.0 technologies and an organisation's strategy. With the rise of such technologies, institutions have had to develop and implement policies that guide the use of such technologies by its members (Linke, 2012). The challenge organisations face with such technologies is balancing these necessary regulations with the flexible nature of these tools. Once again, the creation of these policies will be influenced by the nature of the work being carried out and the structure and organisation of communication functions within an institution. Is it inevitable, therefore, that an organisation such as CERN requires policies to guide the use of social media during an experimental procedure. Exploring this is key then to establishing how Web 2.0/3.0 technologies are used across CERN.

2.4.4 Professional Practice of Media Professionals: Impact of the Digital

As described in Section 2.4.3, one of the forums for debate within the public sphere is news media. With media professionals playing a key role in the moderating of scientific debate in this forum, it is important to understand how the digital age has impacted on their role within media institutes. To provide an initial insight, this section explores a number of studies that have looked at the working practices of media professionals working within online newsrooms. With no empirical studies into Communications Groups within physics institutions found, exploring the roles and working practices of media professionals within media institute will act as a proxy in identifying their function. With both groups involved in the framing of science news and working with similar 'information subsidies' (Gandy, 1982), such as digital and traditional news articles, Press Releases, etc., exploring the research surrounding their working practices provide a useful basis for comparison which can help identify the function and practices of staff in the CERN Communications Group.

Opinion varies as to how technology effects innovation in online journalism. Pavlik (2000), for example, argues that journalism has always been influenced by developments in technology, yet such an explanation is rejected by other researchers. Boczkowski (2004), Haas (2005), Conboy and Steel (2008) instead propose that innovations are mediated by the initial conditions and the context in which they are adopted. Deuze (2007, p153) summarises this, explaining how:

> "Technology is not an independent factor influencing journalistic work from outside, but must be seen in terms of implementation, and how it extends and amplifies previous ways of doing things."

This has also been illustrated in the work of Boczkowski (2004), whose study into three online newsrooms showed how variations in organisational structure, working practices and representation of users all impact on the ways in which media professionals adopt technologies. As such, these factors need to be taken into account within this study when exploring how CERN media professionals use technology in their working and communication practices.

Exploring the research into journalistic practices within online newsrooms reveals a focus on changes in four journalistic practices, those being:

- The editorial work flow;
- News gathering practices;
- Content production;
- Convergence.

Domingo and Paterson's (2008 and 2011) compilations of ethnographic accounts of media professionals within online newsrooms demonstrates the growing research in the area and the use of diverse theoretical approaches, including action theory (Quandt, 2003), social constructivism (Domingo, 2008), actor-network theory and communities of practice (Weiss, 2010) to study various areas. Domingo (2005) describes how much of the early research focused on the content of online news articles, attitudes towards online news and audience reception, rather than the context of online news rooms and changes in practices brought about by new digital technologies. Singer (2008) also notes how these early online newsroom studies were orientated towards identifying best practices for this new form of digital journalism.

For Coleman (2010), research into online newsrooms can help clarify how the adoption of digital media has been translated into working practices and how this has impacted on the professional culture of journalism. This is not to say that the adoption of digital media is the only factor influencing changes in working practices, numerous studies have pointed to various other factors that influence the adoption of digital tools, such as daily routines (Domingo, 2008), workplace organisation (Majoribanks, 2000), available resources (Ursell, 2001), technical skills/multimedia competences (Deuze, 1999) and the needs of the journalist (Domingo and Castello, 2006). Understanding the adoption of digital tools in these ways helps provide an insight as to why pre-digital practices continue in the digital age. Within this study, organisation (Section 2.2.1), digital competences (Section 2.3) and the roles of individual were the primary factors explored to understand the practices of CERN communication professionals.

2.4.5 Exploring the Role of Communication Professionals

To provide a basis for exploring the effects digital technologies have had on the working practices of media professionals, Fahy and Nisbet (2011) developed a typology of the roles of media professionals, specifically related to the roles of science journalists. This provides a broader set of types of media professionals and associated practices, through which the roles of CERN communication professionals can be identified. These have been summarised below:

- The conduit: explains or translates scientific information in their reporting from experts to non-specialist publics;
- The public intellectual: synthesises a range of complex scientific information and its social implications (in which the writer has a degree of specialisation) and presents the information from a distinct, identifiable perspective;
- The agenda-setter: identifies and brings attention to important areas of research which is then picked up and reflected in other science news outlets;
- The watchdog: holds scientists, scientific institutions, industry and organisations to scrutiny;
- The investigative reporter: carries out in-depth journalistic investigations into scientific topics, especially where science meets public affairs;

- The civic educator: informs non-specialist audiences about the methods, aims, limitations and risks of scientific work.
- The curator: gathers science related news, opinion and commentary, presenting it in a structured format, with some evaluation, for audiences;
- The convener: connects and brings together scientists and various non-specialist publics to discuss science-related issues in public, either online or physically;
- The advocate: reports and writes driven by a specific world-view or on behalf of an issue or idea.

(Fahy and Nisbet, 2011, p.4)

Fahy and Nisbet (2011) used these typologies to explore how the adoption and implementation of technologies by science journalists in UK and US media institutes had impacted on their roles. Fahy and Nisbet (2011) found that the roles of curator, convener, public intellect and civic educator had become increasingly more prevalent in the digital age, along with a strong continuation of conduit and agenda-setter role. Furthermore, Fahy and Nisbet (2011) describes the increased plurality of roles involved for science journalists, which involve diverse and interactive ways of reporting science news. This increase in role diversity is in part down to the function of digital news organisations that require journalists to master various multimedia storytelling and newsgathering formats, as well as communicate across multiple mediums and in different formats.

Other studies have focused on the pace of the news cycle within online newsrooms. Boczkowski (2009) and Garcia (2004) argue that online journalism has contributed to the downfall of the twice-a-day-news cycle and the growth of 24 hour news. Boczkowski's (2009) review of various studies that explored the pace of news production suggests that it has increased over time. Rosenstiel (2005) argues that this increase has become a key feature of the media industry in the US, with similar norms of constant publishing during the day being found in online newsrooms in South America (Boczkowski and De Santos, 2007). In this respect, media professionals seem to have adopted one of the practices that digital technologies have made possible which has changed their traditional working practices. Once again, similar effects may have taken place within the context of the communication professionals working at CERN. Within a multi-national organisation such as CERN, research is being carried out 24 hours a day, seven days a week. How then does this translate in the working practices of the CERN Communications Group? Do they work to a similar 24 hour a day, seven day a week cycle?

Some studies have started to look beyond the newsroom and at the role of user participation (Williams, 2010) and bloggers (Lowrey, 2008) and their impact on online journalism. Williams (2010) used multi-site observations of national and local BBC newsrooms and a team of five researchers to track documentation between newsrooms.

Semi-structured interviews were also used to gauge the opinion of journalists towards the use of user-generated content. Williams (2010) found varying attitudes towards the use of user-generated content, indicating that individual agency has a significant impact. Observations of working practices and interviews demonstrated how journalists used traditional journalistic techniques and values when working with user-generated content. In this respect, while the technology may have changed, the principles of journalism have not. Lowrey (2008) used in-depth, semi-structured interviews with six bloggers to identify their routines and how these compare with those of traditional journalism. He found that social, political and economic constraints and pressures influenced the routines of individual bloggers. What can be seen in such studies is the tension between established journalistic practices, and the changes digital technologies can bring, play out in different ways depending on the social, political and cultural setting (Boczkowski, 2009). Furthermore, the research methods used within these studies, combining ethnographic observations and interviews, to explore the working practices of journalists inspired the selection of methods used within this thesis (See Chapter 3).

Lowery (2010) argues both journalism and blogging have developed routines for maintaining audiences, but have unique burdens and advantages. Many traditional media organisations now employ various paid, unpaid and freelance bloggers who operate outside of the newsroom itself. Similarly, CERN has communications staff, along with researchers who blog on behalf of CERN. Anderson (2005) found the blogging carried out by those employed by traditional news organisations resembled the daily work of reporters operating under different technological circumstances. It could be said that this has expanded the boundaries of news production, allowing those outside of traditional journalism to have a greater influence on news production and help shape the nature of public debate. In a similar respect, the use of blogs by academics can open up boundaries between academia and wider publics (Pearce *et al.,* 2011), a central aspect of digital scholarship.

While the degree to which digital technologies have impacted on the ability of external actors to influence public debate within news media can still be questioned, it is clear the newsroom can’t be the only site to study news production (Holliman, 2000). As well as public involvement, Communications Groups like CERN's need to be explored to identify the role they play in science mediation, with such groups often the first to disseminate scientific information. Focusing only on media professionals, one actor in the Circuit of Mass Communication (Miller *et al*., 1998. See Section 2.5) may over exaggerate their importance and risks ignoring the role the other actors play.

2.4.6 The Role of Public Relations in Science Communication

Along with media professionals and publics, public relations professionals play a prominent role in the mediation of information, but one that is less defined and understood. In simple terms, public relations involves presenting the public face of an organisation (or an individual), with practices used to articulate official views, aims and objectives. The primary role of public relations practitioners is to manage relationships with a range of publics and stakeholders, identifying the needs of the group and communicating with them. Gandy (2009, p.134) argues that "the primary role of public relations is of purposeful, self-interested communication. Although modern public relations may involve more efforts to "understand" a variety of publics, this apparent concern [with publics] may be seen as instrumental in that greater knowledge of publics facilitates the more efficient segmentation of those publics for the delivery of targeted communications to them".

While Miller and Dinan (2000) argue public relations now impacts on many areas of British and European political arena, Borchelt and Nielson (2014) describe public relations within the sciences is a relatively new and developing field, with many in the scientific community still unconvinced of the value of building relationships with those outside of the scientific community. Nevertheless, the use of public relation practices by research institutions has increased, with universities, research centres, laboratories employing more science writers/communicators to produce accessible summaries of findings and other relevant information. Similar to Gandy's (2009) description of this classic form of public relations, Borchelt (2008) describes the preferred model of public relations within scientific organisations as primarily one-way and highly asymmetrical, with public relations practitioners within science organisations willing to distribute information, but receive little feedback from their publics. In essence, this is equivalent to the much maligned deficit model[28]. Any attempts to gain feedback from stakeholders is primarily to find out what they think or feel in order to place the right ‘spin’ on their stories (Grunig, 1992), rather than to engage meaningfully with them.

Bauer *et al.* (2007) argues this one-way approach to public relations can negatively affect science and science organisations, fostering mistrustful publics that ultimately reinforces scientist’s views of a deficient public who need to be informed. Many are now calling for an increase in two-way, symmetrical approach to public relations that can help establish better relationships between publics and public relation professionals within science organisations (Grunig, 2006). Once again, it’s hoped digital technologies can provide the channels through which such symmetrical communication could occur, yet the extent to which organisations are listening to their publics remains to be seen (Bauer *et al.*, 2007).

The internet has, for some time, been touted for its ability to transform public relations and provide greater access to and engagement with research (Philips, 2001; Gregory, 2004). Yet numerous studies have shown how universities and research institutions failed to realise the possibilities of the web to communicate and engage with research (Jaskowska, 2004; Lederbogen and Trebbe, 2003; Massoli, 2007; Trench, 2008). While this may be the case, digital technologies, e-mail in particular, has allowed information to be supplied directly to journalists from public relations professionals in more

[28] See Irwin (2009) for a discussion of the deficit model.

accessible ways, allowing it to be easily transferred into other media products (Trench, 2009).

2.4.7 Public Relations Functions of Science Organisations

Within Government-funded research institutes, such as CERN, there are a number of stakeholders that are strategically important to communicate with, including potential funders, other scientific institutes, local communities and journalists[29], in order to establish, maintain and repair trust (Borchelt and Neilson, 2014). Yet much of the research into scientific public relations has focused on the relationship between public relations groups and news media organisations. In one of the earliest studies into this relationship, Nelkin (1995) found that many journalists were effectively retelling science stories rather than investigating them. More recently, this has been referred to as 'Churnalism' (Davies, 2008), and 'desktop journalism' (Holliman, 2000) whereby journalists are over-reliant on public relations materials, such as Press Releases.

As Lynch *et al*. (2014) describe, while personal connections between researchers and journalists are possible, press offices often provide the institutional link between science and newsrooms within universities and research organisations. In many academic organisations, informal or formal guidelines regulate interactions between individual researchers and external media professionals (Peters, 2008), with public relations

[29] These audiences will vary depending on the context and culture of the organisation.

professionals controlling the majority of contact with the outside world. Analysing Press Releases from academic health centres and research hospitals, Lynch *et al.* (2014) demonstrate how such public relations material often favours the concerns of internal audiences (scientists) and how the specific framing choices of public relations professionals can influence how journalists frame their stories. While some argue journalists can have the upper hand over public relations practitioners by having control over the final output of media content (Cottle, 2003a), recent research demonstrates the power Press Releases can give to science organisations when it comes to getting their stories into the public sphere in the form of news (Autzen, 2014; Jarreau, 2014; Lewis *et al.,* 2008; Weitkamp and Eidsvaag, 2014).

As Borchelt (2008) argues, when researching scientific public relations, focusing too heavily on the role of newsrooms provides a very incomplete picture of an organisations public relations activities and their range of stakeholders. L'Etang (2009) also calls for a greater focus on the symbolic construction of public relations functions rather than the products themselves. With this in mind, this thesis aims to look beyond just the media relations aspect of the CERN Communications Group, focusing on their broader public relations functions and the variety of associated practices.

For Borchelt and Neilson (2014), public relations within scientific organisations is focused on developing, maintaining and (when needed) repairing meaningful relationships with various target audiences through the managing of the 'trust portfolio'.

This trust portfolio is the range of strategic communication programmes used to reach these audiences. To be successful, Borchelt and Neilson (2014) argue an organisation has to be effective at four levels of organisational management. These levels are:

- Programme: the individual components of the overall public relations programme, establishing if they meet specific objectives. These programmes need to be well suited to these objectives;
- Functional: the overall public relations functions of the institution, including programme level elements;
- Organisational: public relations functions should contribute to the organisation in some meaningful way (financially, attracting researchers etc.). This requires that public relations has a position at the senior managerial level of the organisation.
- Societal: public relations should help the organisation understand what it means to be socially responsible, helping to build public trust in science and technology more broadly.

In order to understand public relations at these levels, in-depth research into the various actors, audiences and activities is required. Furthermore, research is needed to understand the role of public relations in the mediation of scientific information. This study will attempt to uncover the role of public relations in HEP through the exploration of CERN's public relations functions, using Borchelt and Neilson's (2014) levels of organisational management as an analytical framework. This forms the basis of the next Sub-Questions:

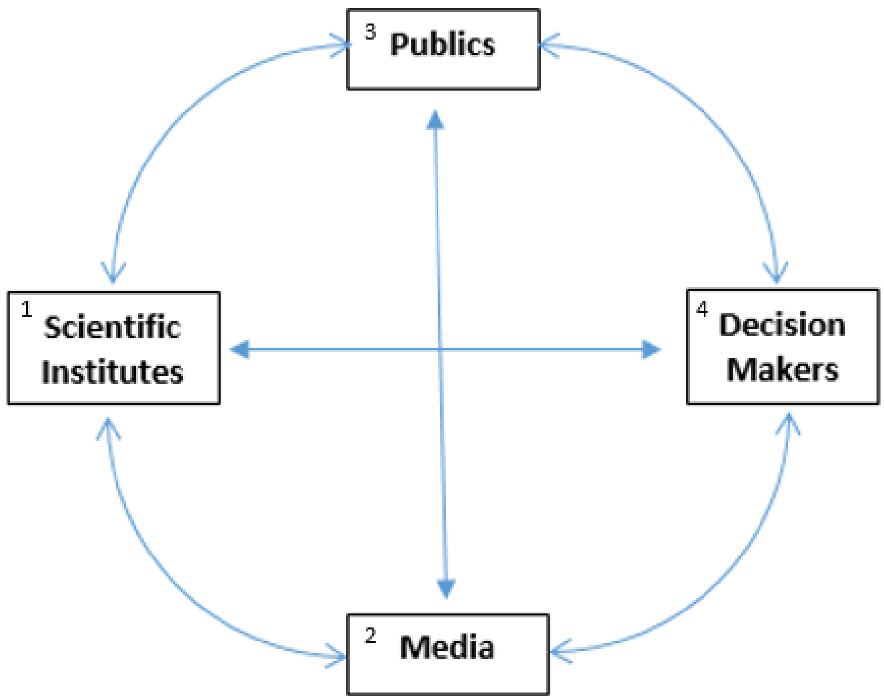
- *Who have CERN identified as key stakeholder audiences?*
- *What is the role of Communications Group in reaching these audiences?*
    - *What routine activities do the Communications Group undertake to engage with their audiences?*
    - *What is the role of public relations at CERN?*

2.5 Science Mediation and the Circuit of Mass communication

This section explores the process of science mediation and looks at the various actors involved, in an attempt to identify where the CERN Communications Group sits within the process.

In order to simplify the complex processes of mass communication, Miller *et al*. (1998) developed the 'Circuit of Mass Communication'. This conceptual model identifies four main sets of actors who interact to influence media coverage of particular events. The process of communication within this circuit is multi-directional, with any two of the four actors connected. Miller (1999) argues that each of these interrelated actors, the pathways between them and content from different moments need to be analysed in order to understand the Circuit of Mass Communication. The circuit is outlined in Figure 2.1.

Figure 2.1: Adapted from Miller et al. (1998) Circuit of Mass Communication.



1. Social and political (Scientific) institutions: These are the organisations that construct/produce new scientific knowledge. In this case this is CERN and the experimental collaborations.

2. Media: Journalists and media professionals in CERN member states (including newsrooms and freelance professionals) reports what is said to;

3. Public (Publics[30]): The publics in CERN member states consume the media reporting, which can potentially impact on the publics' opinion of science. Media reporting and public opinion can be responded to by;
4. Decision makers: Public opinion and media reporting can potentially influence policy making, which may influence further scientific work.

When looking at this circuit, an initial question to ask is where do public relations units, such as the CERN Communications Group, sit within this process? As a group within a scientific institute that appears to carry out many of the functions of the media, it could be argued that the Communications Group play an interesting intermediary role between these actors, often being the first to disseminate information. Yet the evidence is unclear. Communications Groups like CERN’s therefore, need to be explored in order to understand the role they play in science mediation. As outlined earlier in Section 2.4, Communications Group within scientific organisations are an under researched group. Under representing a key actor within the Circuit of Mass Communication in this way may underplay the importance of their role.

While providing an easily accessible representation of the process of mediation of scientific information, it could be argued this model is too simplistic. As well as missing

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[30] Significant actor for the CERN Communications Group. See Chapter 4, Section 4.1.2 for a detailed list of the groups target audiences.

the role of public relations groups within research organisations, the model does not address the diversity within each actor. This is particularly apparent within Miller *et al's* (1998) original 'Public' actor. This has been adapted to 'Publics' for use within this thesis, allowing some delineation between the various audiences targeted by the CERN Communications Group and the specific channels through which they are reached. Furthermore, the circuit itself does not make it clear as to how each of these actors can interact and influence the production, content and reception elements of mass communication (Thompson, 1988). This is particularly relevant in the digital age, whereby digital communication channels have opened up that force is to rethink the way we conceptualise producers and consumers of information (Holliman *et al.,* 2009).

Despite the issues with this model, for the purpose of this thesis, this adapted Circuit of Mass Communication (Miller *et al.,* 1998) provides a useful starting point when exploring the mediation of scientific information coming from CERN. Specifically, this project at CERN is an opportunity to explore the underrepresented relationship between those who construct scientific knowledge (CERN scientists) and those that disseminate the information (CERN media professionals), to shed light on this process within scientific mediation. This forms the basis of the final Sub-Questions:

- *Where does the CERN Communications Group sit within the process of mediation of scientific information?*

- *What is the role of scientific public relations in the Circuit of Mass Communication?*

2.6 Conclusion

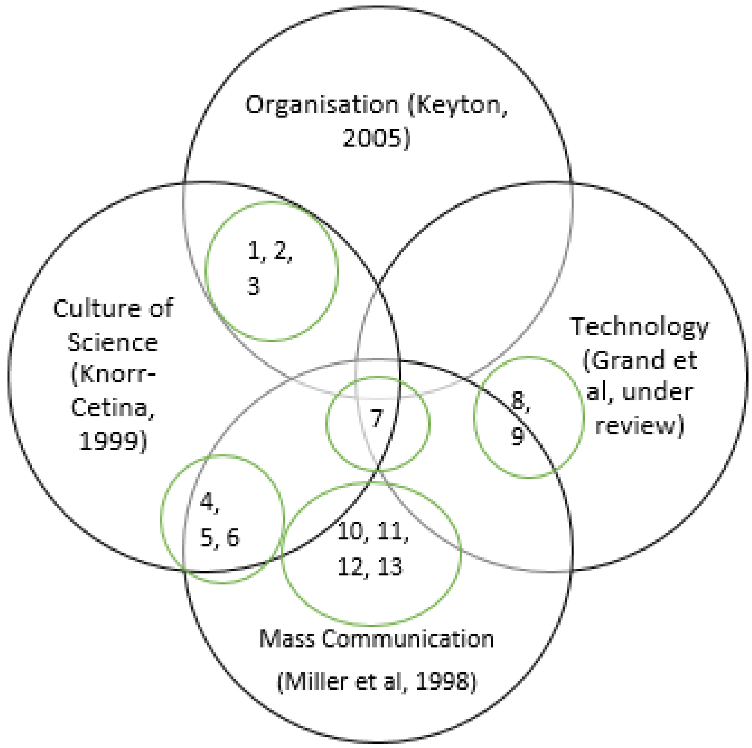
This chapter set out to explore the research area and identify areas worthy of further investigation. The initial exploration into previous research carried out at CERN identified three key studies that explored the various working practices of researchers at CERN from the 60's through to the 90's. As well as helping to trace the development of CERN and place my research into this context, these studies also raised a number of questions as to how communication occurs within such organisations and how the nature of the scientific work impacts on levels of openness.

Research into the literature surrounding communication organisation, digital scholarship and professional practice of media professionals has helped identify frameworks through which the working practices of the CERN Communications Group and digital scholarly practices can be explored. It is argued that, notwithstanding certain criticisms, Miller *et al*'s. (1998) Circuit of Mass Communication provides a useful starting point for exploring the role of the CERN Communications Group in the mediation of scientific information. Within this, Fahy and Nisbet's (2011) typology of science journalists provides a framework through which the professional practice of media professionals in the CERN Communications Group can be explored. Where public relations functions are identified, Borchelt and Neilson's (2014) levels of public relations cab used to examine their effectiveness. Combined, this will provide a broad overview of the function of the Communications Group, allowing their position in Miller *et al's.* (1998) Circuit of Mass Communication to be identified.

To explore how digital scholarship is enacted within CERN, Palmer's (2009) list of the various scholarly activities carried out in the digital age provides an extremely useful activity-based framework for the identification of the scholarly practices carried out by CERN researchers, while Grand *et al's.* (2016) typology of digitally engaged researcher will be adapted in order to explore how the varying use of technology by the participants creates muddled communities of practice.

The use of multiple frameworks in such a way allows a number over distinct and overlapping questions to be explored. The questions outlined throughout the literature review have been listed below, with Figure 2.2 mapping them onto the four key lenses through which they will be addressed.

Figure 2.2: Sub-questions mapped onto the four primary lenses used within this study.



Research Question

How has the concept of openness, and the emergence of digital technologies, influenced the organisational culture of CERN and the practices of CERN researchers and communications professionals?

Sub-Questions

1. *How does CERN's Adhocracy organisation impact on communication practices and openness?*
2. *How does CERN's communications architecture impact on communication practices and openness?*
3. *Where does the CERN Communications Group sit within the organisation?*
4. *How does the nature of the work carried out at CERN impact on the function of the Communications Group?*
5. *Do CERN communication professionals require scientific backgrounds?*

    5a) How does their background effect their working practices?

6. *How does the nature of the work carried out at CERN impact on openness?*
7. *How have digital technologies impacted on the communication practices of researchers and communication professionals working at CERN?*
8. *How are digital technologies used for engagement purposes by CERN researchers and professionals?*
9. *What factors influence the use of digital technologies by CERN researchers and professionals?*
10. *Who have CERN identified as key stakeholder audiences?*

11. *What is the role of Communications Group in reaching these audiences?*
    - *What routine activities do the Communications Group undertake to engage with their audiences?*
12. *Where does the CERN Communications group sit within the process of mediation of scientific information?*
13. *What is the role of scientific public relations in the Circuit of Mass Communication?*

To address the Research Question and the range of Sub-Questions, a suitable methodology needs to be in place. In the following chapter, a mixed methods approach will be outlined, focusing in particular on how document analysis, semi-structured interviews and ethnographic approaches were drawn on to study the practices of staff working in the CERN Communications Group.

Chapter 3 Methodology

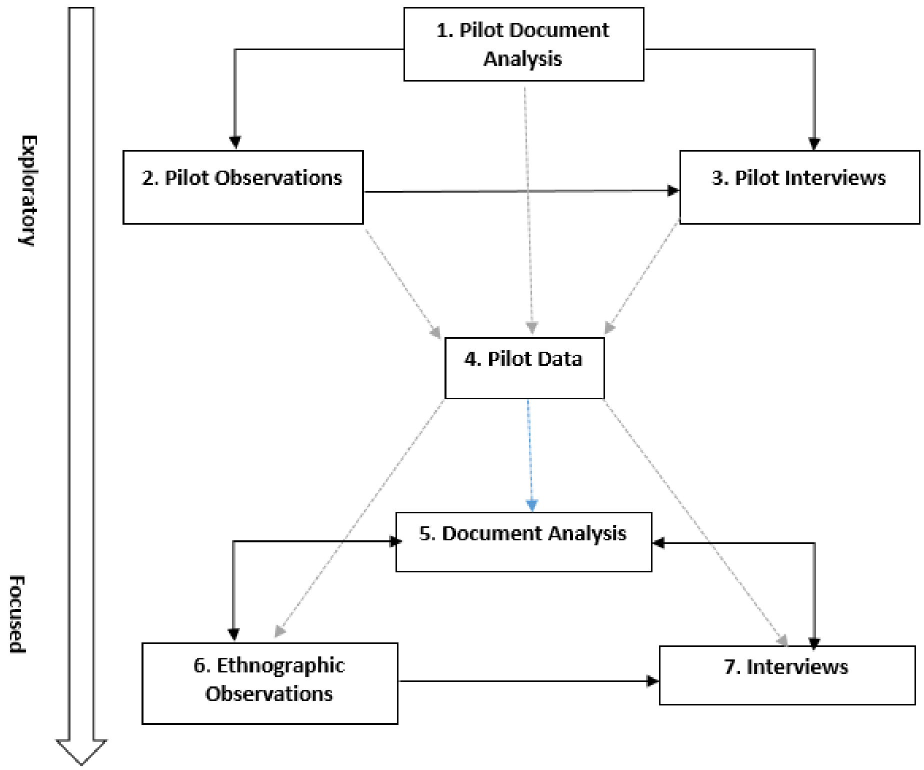
This chapter outlines the mixed methods approach used within this study to explore the ways in which CERN research becomes public in an era of digital scholarship, and its implication for academics and media professionals. A mixed methods approach was adopted, combining ethnographic observations, semi-structured interviews and document analysis to fully explore the research question and Sub-Questions (Chapter 2, Section 2.6). The mixed methods approach developed was based on the methodological framework of complementary assistance (Morgan, 1998) and was sequential exploratory (Creswell *et al.*, 2003) in design, with two distinct but related phases of data collection[31] (Figure 3.1).

Figure 3.1 illustrates the phases of data collection and analysis and the methods used at each stage. Document Analysis was the first method utilised, providing an initial overview of the research area during the pilot study (Chapter 4). The documents identified helped formulate questions for the pilot study interviews and provided leads for initial observations. Analysis of the pilot study data had direct impacts on the methods used in the main study. Within the main study, selected methods combined and, at some stages, came to inform the other procedures more so than during the pilot

[31] Mixed method, sequential exploratory design and complementary assistance are discussed further in Section 3.1.

study. For example, further documents were identified during the interviews and ethnographic observations, which again influenced interview protocol and observations.

Figure 3.1: The Stages of the Data Collection Process.



This chapter continues with a review of the literature into mixed methods as a methodological approach and the implication of adopting such an approach (Section 3.1). This is followed by a detailed account of the chosen methods justifying the selection of each and its purpose within this study (Document Analysis, Section 3.2; Ethnography, Section 3.3; Semi-structured interviews, Section 3.4). The chapter concludes with a summary of how the various data streams were combined through thick description (Section 3.5).

3.1 Methodological Approach

After reviewing a number of studies that have used a combination of methods to explore the impact of technology on working practices in newsrooms (Boczkowski, 2004; Lawson-Borders, 2003; Meier, 2007) and the benefits that methodological triangulation can have on validity (Seale, 1999) and reliability (Bush, 2002), a mixed methods approach was adopted within this study.

This section will explore the implications of carrying out such an approach, including the effects of methodological (Jensen and Holliman, 2009), data and researcher triangulation (Banik, 1993) and complementary assistance (Morgan, 1998).

3.1.1 Methodological, Data and Researcher Triangulation

Methodological triangulation involves the use of multiple methods to address a single, overarching question (Jensen and Holliman, 2009), while still allowing multiple other inquires to be made. Combining multiple methods, such as ethnographic observation, interviewing and document analysis can help provide a rich source of data and a clear overview of what is being studied (Engel, 2007). For Singer (2008), the use of methodological triangulation helps to clarify what has been found through analysis of distinct but complementary data sets. Examples within newsroom research include Boczkowski (2004) who used a combination of ethnographic observations and extensive interviews to explore the adoption of technology in three online newsrooms. Boczkowski (2004) also collected and analysed a wide array of relevant documentation, both public and corporate, and analysed each newsrooms website. Lawson-Borders (2003) used ethnographic observations, interviews and document analysis when exploring news organisations of three American cities to develop a framework for best practice in online newsrooms. Meier (2007) combined interviews with online surveys to examine how reconfiguration of workspaces following the implementation of technology and new platforms had impacted working practices and the quality of journalistic work.

Triangulation of methods also helps reduce the weaknesses of a single method if those chosen complement each other, which could yield greater validity and reliability (Jensen and Holliman, 2009). Observation, for example, has been criticised for subjective interpretation on the part of the researcher, which can bring into question its reliability and validity (Angrosino, 2007). Furthermore, the 'observer effect' relates to the participants in the research whereby people change their behaviour when under study (Angrosino, 2007). This is another problem within observational research (unless undertaking the complete observer role). Issues, such as observer bias, draw into question the objectivity of the findings, as already held beliefs or experiences could consciously or unconsciously impact on how the observer sees certain behaviours. Such bias can be minimised, however, through researcher triangulation, by which interpretations are reviewed by an outside researcher. As Banik (1993) describes, researcher triangulation can help increase the validity and reliability of findings. However, this should not be taken as a given, as researcher triangulation may amplify researcher bias, rather than decrease it.

While it is important to keep objectivity in mind, the ability to remain completely objective is impossible within observational research (Denzin, 1997). Observations require a researcher to make inferences about what is going on around them, which will be relevant to a particular set of research questions. These, in turn, will be informed by the researcher's theoretical approach, disciplinary background, and so on. Indeed, some researchers argue it is not possible to detach a researcher from a situation without imparting meaning to it (Denzin, 1997). It follows that the question of validity may well be more relevant within observational research, with researchers aiming to provide a valid account of processes and practices. As such, validity will be the key within this study, providing an accurate account of life in the CERN Communications Group.

The combining of semi-structured or open ended questions alongside observation and document analysis as part of a study, can help achieve this accuracy; giving those being questioned the ability to talk openly and relatively informally, using their own language and terminology (Holliman, 2005), complemented with observations, can increase validity and reliability. The subsequent narrative combines the use of quotes to compare with what has been observed. These approaches, which can involve interviews or focus groups, should allow for digression that could help open up new avenues of investigation. Combining the data collected from these complementary methods (data triangulation) can provide a more comprehensive understanding of the research area and strengthen overall conclusions being drawn. Problems may arise, however, from the large amount of what can often be unstructured data that such triangulation can give.

Along with interviewing, document analysis is another method that can work well with observations. This involves analysis of relevant materials, both primary and secondary sources, related to the field of study (Angrosino, 2007). Within organisational research, this may include communication strategies, working guidelines, minutes from meetings, etc[32]. Document analysis will often be used at the early stages of the research, providing insights into the area and helping to form the development of research questions. However, it is also important to remain open to revisiting further relevant documents as the research progresses, allowing the researcher to track changes that have occurred over time, and providing comparative data on current practices (Bowen, 2009).

The methodological approach used within this thesis is based on a framework of complementary assistance (Morgan, 1998). While often used interchangeably with the term triangulation, (Yauch, 2003), complementary assistance refers more to the clarification or enhancing of results through the use of different methods to study different aspects of the research area. In this respect, triangulation can be said to corroborate data, while complementary assistance supplements the data. To achieve both triangulation and complementarity, methods should be used that explore questions that directly overlap and those that remain distinct.

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[32] The Documents used within this thesis are outlined in Section 3.2.1.

The design of the mixed methods approach used within this thesis was also sequential exploratory in design (Creswell *et al.*, 2003), with two distinct but related research phases of research (outlined in Figure 3.1). Such a design differs from ‘concurrent’ data collection, whereby data is collected from various strands simultaneously. The benefit of a sequential exploratory design is that it allows methods to be integrated and to complement each other. For example, within this thesis, observations raised new questions that were added into later interview protocols. Combining exploratory and focused steps within this research allowed for a broader overview of the research area to be gained, along with a more in-depth, systematic understanding of specific areas.

3.2 Document Analysis

This section explores the rationale behind the use of document analysis, including the strengths and limitations of the method, and the process by which it was carried out within this thesis. Document analysis formed a key part of both the main and pilot study. Within the pilot study (Stage 1, Figure 3.1) document analysis was used in an exploratory manner, providing an initial insight into the research area and helping identify areas for further research. In the main study (Stage 5, Figure 3.1) document analysis became more focused, being used to complement other data streams.

Bowen (2009) describes document analysis as a systematic procedure for reviewing or evaluating documents, be they printed or electronic materials. This involves analysis of relevant materials, including, primary, secondary and tertiary sources and grey literature that is related to the field of study (Angrosino, 2007). Just like other qualitative methods, document analysis requires interpretation of the data in order to elicit meaning and gain an understanding of what is being read. The types of documents that may be analysed within communication and/or organisational research goes beyond standard research literature to include strategies, job descriptions, minutes of meetings, Press Releases, organisational reports, survey data and many other forms of public records[33]. Indeed, 'Documents of all types can help the researcher uncover meaning, develop understanding, and discover insights relevant to the research problem' (Merriam, 1998, p.118). Atkinson and Coffey (1997, p.47) remind researchers to consider carefully how document analysis can fit into their research. They argue that researchers:

> “[...] should not use documentary sources as surrogates for other kinds of data. We cannot, for instance, learn through records alone how an organization actually operates day-by-day. Equally, we cannot treat records—however ‘official’—as firm evidence of what they report [...] That strong reservation does not mean that we should ignore or downgrade documentary data. On the contrary, our recognition of their existence as social facts alerts us to the

[33] Documents used within this research are outlined in Section 3.2.1.

necessity to treat them very seriously indeed. We have to approach them for what they are and what they are used to accomplish."

It's important, therefore, to understand how document analysis can be used within a study and the benefits and limitations of the method, as outlined by Bowen (2009, pp. 31-32) in Table 3.1.

Table 3.1: Strengths and limitations of Document Analysis (Bowen, 2009, pp.31-32)

Advantages	Disadvantages
Efficiency: Less time consuming, requiring data selection rather than collection.	**Insufficient detail**: Document analysis alone may not provide sufficient detail to answer a research question.
Availability: Many documents are in the public domain.	**Limited access**: Documents may not be retrievable or difficult to retrieve.
Cost-effective: Less costly than other methods	**Biased selectivity**: An incomplete collection of documents may provide a partial sample.
Less obtrusive: Documents (for the most part) are unaffected by the research process.	
Stability: Can be repeatedly reviewed and analysed.	
Coverage: Can provide broad coverage, spanning long times, events and changes.	

Stake (1995) outlines the suitability of document analysis within organisational case studies – intensive studies providing detailed descriptions of organisational cultures/procedures. Reports, internal and external correspondence are all potential sources of empirical data for such studies. Documents can serve a variety of purposes within such research. Firstly, documents can provide information on the context in which the research participants operate (Bowen, 2009), along with background information and historical insight into an organisation. This information can help a researcher understand the roots of specific issues under study. Secondly, information obtained from documents may raise questions that need to be asked or activities that could be observed as part of the research. Thirdly, information and insights from relevant documents can provide supplementary research data, providing valuable knowledge alongside other data sources. Fourthly, document analysis can allow the tracking of changes and developments of an organisation. Such things as draft proposals and various versions of strategies can provide comparisons and insights into how and when these changes occurred, as well as allow the gathering of data from past events. Finally, documents can help to verify findings and data from other sources.

With a lack of previous literature into Communications Groups, the potential of document analysis to perform these exploratory functions made it a suitable starting method. Analysis of documents that outline the communications structure and architecture of CERN can help position the Communications Group within CERN and provide information into the context in which it members operate. Questions raised through the analysis of such documents could then be explored through other methods. This is where the value of document analysis often lies, within methodological and data triangulation, combining document analysis with other research methods in the same study to help corroborate results through the use of different data sources and methods (Bowen, 2009). The next section explores the procedure through which documents were gathered and analysed within this thesis, including how data from the analysis was integrated with other methods.

3.2.1 Procedure

As outlined in Figure 3.1, document analysis was carried out in an exploratory manner within the pilot study. Documents were initially identified and analysed in the early stages of the pilot study, between September 2012 and November 2012. These documents included:

1. CERN's 2012-2016 Communication Strategy (CERN, 2011);
2. LHC Communication Plan, 2006 (CERN, 2006);
3. CERN Strategic Communication Plan, 2009 (CERN, 2008);
4. CERN's Annual Report 2012 (CERN, 2012);
5. CERN Code of Conduct (CERN, 2010).

These documents were primarily identified through informal visits with members of the Communications Group. In some instances, copies of the documents were provided by the respondents, in others documents were referred to and searched for electronically. As all of these documents had been made public by CERN through the CERN Document

Server[34], searching and accessing these documents was relatively easy. Further searchers were carried out through this server, using similar search terms as those used in the literature review. This included 'Communication', 'Communications Group', 'Organisation' and 'Openness'.

Within the main study, document analysis became a more systematic process as the focus of the research was narrowed. Documents that had previously been analysed within the pilot study were analysed using a more rigorous approach. Further documents were obtained following on from the interviews and ethnographic observations carried out during the pilot study. Additional documents identified were:

- Social Media Guidelines, (CERN, 2014);
- Staff Rules and Regulations, 2007 (updated 2013) (CERN, 2013);
- CERN Press Releases relating to specific events (e.g. Observation of Higgs like Boson[35], Open Access Initiative Launched at CERN[36]).

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[34] CERN Document Server, https://cds.cern.ch/, last accessed 19.01.2016.

[35] CERN Press Release: Observation of Higgs Like Particle, http://press.web.cern.ch/press-releases/2012/07/cern-experiments-observe-particle-consistent-long-sought-higgs-boson, last accessed 19.01.2016.

[36] CERN Press Release: Open Access Initiative Launched at CERN, http://press.web.cern.ch/press-releases/2012/10/scoap3-open-access-initiative-launched-cern, last accessed 19.01.2016.

The process behind the analysis of these documents combined elements of content analysis and thematic analysis (Bowen, 2009). Documents were initially read to gain an overview of their content and relevance to the study. This was followed by a more thorough reading of the texts, identifying relevant quotes and passages of text. Texts were then arranged into categories, coding the data to identify broad themes. Certain predetermined themes, such as those around openness, organisation, digital scholarship, communications, were used as initial lenses when categorising the data.

As with the pilot study, data from the document analysis within the main study was integrated with the methods that followed. Document analysis helped to develop questions to be asked during the interviews, as well as provide an initial insight into the context in which the ethnographic observations were carried out.

3.3 Using Ethnographic Approaches to Study Processes of Mediation

The following section examines how ethnographic methods have been used to explore working practices of various communication professionals, and why it was chosen for use in this thesis. While the search of the literature showed a lack of empirical studies into a Communications Group within a HEP organisation, the use of ethnographic approaches in the study other communication professionals (journalists, filmmakers, bloggers, other broadcast media, etc.) indicated its potential suitability for researching the CERN Communications Group. The exploratory nature of ethnography makes it an ideal method for uncovering information about people and groups when little is known about them (Hammersley, 2007), as is the case with this research at CERN. The majority of this section focuses on the use of ethnographic practices to study newsrooms and the working practices of journalists and how these examples were adapted and used to develop a suitable approach for this research at CERN.

3.3.1 Pre-digital Ethnography

In its broadest sense, ethnography comprises a particular method or set of methods involving direct contact in the daily lives of a selected group of people for an extended period of time, observing, listening and recording what is happening in order to understand it (Hammersley, 1990). The development of the ethnographic methodology is closely related to the history of social anthropology. In the 19th and early 20th century, attempts were made to overcome the perceived methodological weaknesses of the early social sciences by making information gathering a more systematic and rigorous pursuit (Hammersley, 1990). In the mid-20th century, influenced by the works of social and cultural anthropologists such as Malinowski (1922), Mead (1928), Evans-Pritchard (1940) to name a few, there was a move towards anthropologists living amongst groups being studied in order to observe first hand. Malinowski’s (1922) fieldwork amongst the Trobriand Islanders and his subsequent diary (Malinowski, 1967) was one of the first uses of participant observation, living and interacting with those under study, to generate anthropological knowledge.

As well as anthropologists, sociologists have used ethnographic methods since the early twentieth century, with use increasing throughout the 1960s, 70s and 80s. Efforts were made during this time by the likes of Glaser and Strauss (1967) to enhance the rigour of the ethnographic approach through such things as codifying research, developing theories from research that are grounded in data rather than deducing hypotheses from existing theories. These efforts helped ethnographically-informed approaches overtake the then dominant survey methodology (Hammersley, 1990).

For the purpose of this research, ethnography can be associated with the 'naturalist researcher'; broadly following the idea that the world can be studied in its 'natural' state instead of in artificial, 'laboratory based' conditions (Hammersley and Atkinson, 1995). This is in contrast to positivist approaches that value standardised techniques to help control variables (Hammersley and Atkinson, 1995). What the naturalist researcher values is the context in which the behaviour takes place, how it occurs and how it is viewed by those involved (Hammersley and Atkinson, 1995). As a result, ethnographic approaches can allow researchers to analyse people's behaviour in specific contexts. As well as arguably being more valid than experimenting in an artificial setting, the naturalistic researcher argues it is more valid than interviews in which people only say what they do (Hammersley, 1990). Naturalism also implies that social practices can be more effectively explained in terms of the relationship to the context or culture in which they occur (Hammersley, 1990). It is therefore crucial that ethnographers learn and understand the context and culture of those under study. For ethnographic researchers, observation can be combined with other methods, e.g. open-ended or semi-structured interviews, to provide a fuller understanding of a group’s culture. Within this thesis at CERN, combining document analysis alongside observations helped to provide a fuller understanding of the culture of the Communications Group.

The potential of ethnography for the study of media professionals was summarised by Schlesinger (1980). He spoke of the ability of ethnographic methods to make basic information about working practices of media professionals available to researchers through systematic observation of their social practices. In his study of the BBC newsrooms in the 1970's, Schlesinger (1980) used ethnographically informed methods, including four years of observations and 95 interviews with members of the BBC's radio and television newsrooms to explore theories of news production.

Given some of the similarities in organisation and professional practices between newsrooms and the CERN Communications Group, ethnographic approaches were explored to see how feasible they would be in researching the associated practices of their staff.

3.3.2 Pre-digital Ethnographies of Newsrooms

The use of ethnographies to analyse the culture and working routines of pre-digital journalists began in the 1970’s (Tuchman, 2002) with sociological studies by Buckalew (1970), Epstein (1974), Altheide (1976) Warner (1971) and Schlesinger (1987), focusing on production in television newsrooms. Such studies demonstrated how ethnographic approaches could be used to study news producers, their cultures and qualify theories of news manufacturing held at that the time (Cottle, 2000). Cottle (2003b) argues the theoretical frameworks used in these 'first wave news ethnographies' was that of organisational studies. Willig (2013) points out that because of this, these studies often ignore other questions, such as those of economy, culture, power and politics. While acknowledging the impact such studies have had on current understanding of news production, Paterson and Domingo (2008) argue the relevance of these studies, carried out through the 60's and 70's, has significantly decreased, with modern newsrooms bearing little resemblance to those of the past. One of the key reasons for this has been the embedding of digital media into newsrooms and the creation of online news platforms that required media professionals to extend and develop their skills (Allan, 2006).

3.3.3 Ethnography in the Digital Age

Coleman (2010, pp.488-489), when referring to the study of digital media, had the following to say about the use of ethnography:

> "To grasp more fully the broader significance of digital media, its study must involve various frames of analysis, attention to history, and the local contexts and lived expectations of digital media – a task well suited to the ethnographic enterprise."

Domingo (2003) summarised some of the pros and cons of the ethnographic method for research into online journalism, updating the suggestions made by Schlesinger (1980) about the use of ethnography in media research and incorporating his own experiences in online news rooms (Table 3.2).

Table 3.2: Pros and Cons of ethnographic methodology for research into online journalism (Domingo, 2003, p.3).

Pros	Cons
Gathers lots of rich first hand data.	Observation can be time consuming.
Direct observation of patterns, routines and social and technological interactions.	Difficult to record everything that is going on around, especially when it comes to the use of technology.
Researcher can gain an insiders point of view.	Those being observed may resist the study.
Researchers can witness conflict, changes and evolution.	Maybe difficult to generalise the results of the study.
Analysis provides in-depth descriptions of the use of technology and provides understanding of the factors involved in its social construct.	The researcher needs to be aware of their opinions in order to avoid negative impacts on the study.

After his experiences, Domingo (2003) recommends the use of ethnographic observations to get a deeper understanding of developments in media, the use of technology and its social meaning. However, a lot has changed within news media between Schlesinger's (1980) study from the 70's and Domingo's (2003) study. The creation of twenty-four hour rolling news; decline in newspaper readership and increase in online readership; introduction of digital communication technologies; computers taking over from typewriters; further extension of transnational conglomerate media giants; extension of citizen journalists and development of new media products have all impacted on the way newsrooms work (Klinenberg, 2005). Despite this, the increased use of digital technologies within newsrooms has not necessarily created new problems when it comes to carrying out ethnography, but may have exacerbated them. Observation of working practices has always been difficult, even in the pre-digital age. In Schlesinger's time (1970's-1980's), the use of technologies, such as typewriters and telephones, made direct observation and recording of all practices difficult. With the implementation of digital technologies, such as email, instant messaging, blogging, social media, etc., into newsrooms and communications groups, practices may have become further concealed (in effect, black boxed), making observing and tracing along these channels difficult. While digital traces of communications exist, such as email correspondence, gaining access to them can be problematic. The decentralisation of news production, whereby news sites can be edited and updated from outside the traditional walls of the newsroom, makes this type of research even more problematic.

As described, the increase in digital technologies may have exacerbated the issue of access within observations, but it is not new to digital newsrooms. This indicates that despite changes in technologies, proven methodologies such as ethnography remain relevant in the digital age if adapted to new contexts, and can still be used to answer questions relating to the working practices of specific groups. Ethnography can allow researchers to gather rich empirical data to find the way in which technology is used, the factors that influence its use and social relations that are formed around technology, as well as the continuity or change in associated practices. As such, ethnographic approaches were deemed appropriate to use within this thesis when exploring the working practices and technology use of researchers and communication professionals at CERN.

Domingo (2005) also points out that empirical research using surveys or content analysis alone will often ignore the historical perspective of technological development and the social context of the online newsroom. Boczkowski (2002) explains that when actual practices are not observed, researchers cannot gain a full understanding of how technology enters a society and how it impacts on practices. Therefore researchers "may build analysis upon a usually taken-for-granted technologically deterministic matrix" Boczkowski (2002, p.279).

More recently, Cottle (2007) argued that an ethnographic approach for the study of newsrooms and news production could help reveal the constraints, contingencies and complexities with the newsroom and provide a greater understanding of the processes behind news production. Paterson and Domingo (2008, p.2) also argue only ethnographic methodologies can "come close to providing adequate descriptions of the culture and practices of media production and the mind-set of media producers". Such research would be all but impossible using other methods, such as surveys and content analysis, alone. Yet these methods can also offer valuable insight into the process of communication, especially when used along with ethnography as part of a mixed methods approach. Analysis of media content, for example, can help explore the content of media products, while ethnography can provide an insight into their production and potentially their reception[37]. Together this can provide a deeper understanding of communication as a whole.

Domingo (2005), in his review of studies into online journalism up to 2004, described how much of the research focused on the content of online news articles, attitudes towards online news and audience reception, rather than the context of online news rooms and changes in practices brought about by new digital technologies. Singer (2008) also notes how these early online newsroom studies were orientated towards identifying best practices for this new form of digital journalism. Paterson and Domingo (2008) felt this lack of research into the production of online news came down to issues of access. The issue of access is explored further by the likes of Batabyal (2007), Garcia (2004), Silverstone (1985) and Tuchman (2002). This problem of access highlights one of the limitations of ethnography; it can be intrusive, requiring significant commitment from those under study without any guarantees of what might be found. It requires those under study to 'trust' in what the researcher is doing and be open to possible

[37] See Chapter 1, Section 1.4.1 for a discussion of Thompson (1988) and the production, content and reception elements in the process of mass communication.

criticism. Professional experience can go some way to help facilitate access and reduce these issues (Paterson and Zoellner, 2010). Relevant experience in the field of journalism also gives a better understanding of what's being observed from the outset, as well as helping to increase disclosure from those journalists and media professionals being studied. For a researcher this can be extremely valuable. In his ethnographic study of four Spanish newsrooms, Domingo (2003) found his previous experience as a journalism student meant he had an understanding of the professional mindset of journalists and the routines of news making. This allowed his initial period of observation, that time when a researcher learns the rules, routines and roles of a group, to be much shorter. Yet many researchers would argue that going into a field with limited experience can also be valuable, as it allows the researcher to distance themselves from what is going on around them, reducing potential researcher bias (Paterson and Zoellner, 2010).

As a joint project between the OU and CERN, and due to CERN's attitude towards openness, issues over access were reduced within this thesis, with negotiations taking place before the start of the thesis. Despite this, negotiations were still required throughout the study to gain access to participants, attend meetings and for permission to make audio recordings as needed. With no professional experience working in a Communications Group, my initial periods of observations during the pilot study were crucial in gaining an early insight into the culture and working practices of the group. During this time I observed a broad range of practices, switching to a more focused approach during the main study when areas of interest had been identified (see Section 3.3.5).

3.3.4 Observation in Ethnography

Observation is an important technique within ethnographic research. While it is important in our decision-making process in everyday life, observation within research is a more formal and systematic process (Picken, 2010). Within the context of ethnographic research, regular and repeated observation of individuals or groups of people during certain situations provides us with an understanding of the nature of groups and social organisations. Observation involves more than just the visual; it requires awareness of information coming from all senses (Picken, 2010). Stokes (2013) advocates the use of the participant observation method of ethnography in order for researchers to gain a better understanding of the site and people under study by becoming part of the environment and participating in routines as if they were part of the community. Media researchers often use this method of observation, but it is nevertheless just one possible way of observing. Gold (1958, pp. 217-222) distinguished four categories of ethnographic researcher based on level of interaction. These have been adapted and summarised here as:

The Complete Observer: The researcher observers covertly, keeping themselves detached from those being studied. Such an approach is objective, although it often requires deception and can make consent difficult, which raises ethical questions.

Observer as Participant: The researcher conducts observations for small periods of time in order to gain early contextual information to help inform further research, such as interviews or follow up studies. Those under study identify the researcher as such, with little direct interaction between the two.

Participant as Observer: The researcher is more immersed and engaged in with those under study. While still being identified as a researcher and having their research activities acknowledged, there is a closer relationship between researcher and subject.

Complete Participant: The researcher is fully immersed and fully engaged with those under study and what they do, so much so the nature of the study may not be completely divulged. It is thought such an approach allows the researcher to gain a closer relationship with their subjects, however this can also have a negative impact on the researcher's ability to carry out their work. Just like the complete observer, the complete participant role may also bring about ethical issues in terms of deception and consent.

Adopting an approach to observation is not a simple process. A researcher may not be able to carry out the type of observation they want, or may not even know which approach is best for them at the start. The first, and arguably most important, stage in social research involves the negotiation of physical access, as well as the consent of participants. The results of these negotiations may impact on the role a researcher can adopt. A researcher may also have to adapt their approach as the study progresses if circumstances change.

After exploring the multiple forms of observational ethnography from the literature, and trialling the approach by shadowing with one of the projects supervisors, an observer as participant approach was adopted within this thesis. Through the initial negotiations with participants (see consent form, Appendix C) and throughout the observations, I was identified as a researcher by all those observed, including introducing myself as such to those in attendance at meetings. Yet, I remained flexible in my observational approach, making it possible to switch from an observer as participant to participant observer when required and deemed suitable. How this approach worked in practice is outlined in Sections 3.3.5.1 and 3.3.5.2.

3.3.5 The Ethnographic Research Process

There are certain steps involved in all observational research. This is not to say, however, that this is a linear process, nor that there is a simple 'formula' to follow. Some of the steps taken within observational research have been summarised below. These steps, as outlined by Spradley (1980, pp.93-94), provide a broad framework for carrying out observational research, which provided the basis of the ethnographic process carried out within this project.

Stage 1 – Site selection, access, negotiation and ethics.

In the initial conceptualisation of the research where ethnographic approaches are seen to be a useful methodological approach an appropriate location will be identified. Access is negotiated, with entry to the site and participants requiring discussions with a gatekeeper. Ethical issues and access to data should also be considered.

Stage 2 – Initial observation period.

Initial observations are carried out to give a general overview of the issues and participants under study. Observations will be recorded in some way, ideally e.g. using field notes, but also potential through audio, video recordings, and photographs. This allows for easier retrieval and analysis down the line.

Stage 3 – Analysis of initial observations.

Both during the observations and after, reflections should be made on what has been observed. Notes should be written up soon after the observations to allow for easier recall. Initial observations should be analysed to identify early themes and areas for further investigation

Stage 4 - Structured observation and funnelling.

Themes emerging from initial observations can be explored in more detail through further structured observation. Further questions may arise that may be answered through additional observations or other methods, such as interviews, questionnaires, etc. This is often referred to as 'funnelling', where the direction of the research becomes more focused.

Stage 5 – Analysis and follow up.

Audio and video recordings should be transcribed ready for analysis. Interpretations based on a theoretical framework can be made which can be followed up through further observations or other approaches.

(Adapted from Spradley, 1980, pp. 93-94)

This section continues with an outlining of the ethnographic process of both the exploratory observations as part of the pilot study, and the more focused observations that were used in the main study.

3.3.5.1 Ethnographic research process: Stage 1-2

For the majority of the research, observational data was collected at CERN's Meryin Site, Switzerland, where the CERN Communications Group is based, with access being provided by one of the thesis supervisors, the Head of Communications at CERN. As demonstrated in the floor plan in Appendix A, rather than being in the same location, the Communications Group is spread out in separate offices across the Meryin site. At the time of the research, the Communications Group was made up of 16 individuals, working on a mixture of Indefinite Contracts and Limited Duration Contracts[38].

As with all ethnographic research, a number of ethical considerations had to be made before carrying out this study. Ethical guidelines outlined in the British Sociological Association statement of Ethical Practice[39] were followed when considering the ethical issues of this thesis and requesting approval for the study from the Human Research Ethics Committee (HREC) at the Open University. The HREC process involved completing the HREC proforma, outlining the intended methodology and providing consent forms and information sheets for review.

With the pilot study observations designed to be exploratory, observer as participant observations were carried out with the whole of the Communications Group to provide

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[38] The CERN Communications group is currently staffed by 19 individuals (December, 2015).

[39] Statement of Ethical Practice, http://www.britsoc.co.uk/about/equality/statement-of-ethical-practice.aspx#_prof, last accessed 19.01.2016.

an initial overview of their functions. This also helped to identify potential research areas and participants for the main study. Through the observer as participant approach, I was able to establish relationships with the various members of the Communications Group and learn more about them at this early stage.

Initial pilot observations were carried out around the time of the Higgs update (1st - 6th of July, 2012) where the Communications Group was observed working in a 'heightened' state as they prepared for pre-planned media events and Press Releases. During this time, the Communications Group were observed liaising with journalists and researchers, arranging interviews between these two actors. The Communications Group would also field some questions from the media directly, with a number of the group holding physics PhD's. Field notes were taken during these observations, however, these were relatively unstructured. Press Releases and media packs were also gathered and formed part of the document analysis (See Section 3.2).

Further observations were carried out with the Communications Group in November, 2012, when the group was working in a more 'steady state', i.e. there were no planned media events. As well as observations with the Communications Group, a number of meetings between the Heads of Communications from High-Energy Physics labs around the world, communicators from physics institutes in CERN member states, as well as meetings between the Heads of the Communications and Engagement teams for each of the experiments at CERN were attended. This included a meeting of the InterActions[40] collaboration, a group representing the particle physics laboratories in Europe, North America and Asia, and a joint meeting between the European Particle Physics Communication Network[41] (EPPCN) and the International Particle Physics Outreach Group[42] (IPPOG), made up of communication professionals from CERN Member States and the experiments.

Once again an observer as participant role was undertaken within these observations. Field notes were taken during the meetings, including specific quotes and interesting statistics, then more detailed summaries were written at the end of each day. Some presentations within these meetings were audio recorded and the slides made available.

3.3.5.2 Ethnographic research process: Stage 3-4

Following on from the exploratory pilot study observations, focused observations were carried out, exploring the working practices of CERN Communications Group staff and researchers, in particular the social practices of the Communications Group in mediating scientific information for publication and their interactions with CERN researchers and other communication professionals. These focused observations provided more

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[40]About InterActions, http://www.interactions.org/cms/?pid=1000025, last accessed 19.01.2016.

[41]EPPCN, https://indico.cern.ch/getFile.py/access?contribId=5&sessionId=1&resId=1&materialId=slides&confId=69937, last accessed 19.01.2016.

[42] IPPOG, http://ippog.web.cern.ch/, last accessed 19.01.2016.

manageable data in comparison to the unstructured notes of the pilot study. An observation protocol was developed, focused on tracing and following the activities of the various participants (Appendix B).

These observations were carried out in March, 2014, with selected members of the Communications Group. Of the sixteen members of the Communications Group, the six senior members of the various sub-teams within the group were selected. This provided a broad perspective of the various communication functions that the group undertake, speaking to Sub-Questions 10-13 that focus on the role of the Communications Group and their position in the Circuit of Mass Communication (Miller *et al.,* 1998). Two CERN researchers were also observed to provide an additional external perspective on communications, and to help explore the relationship between the Communications Group and researchers at CERN. Observations with CERN researchers also helped explore Sub-Questions 4, 6, 7 and 8.

The eight participants comprised:

- Head of Communications;
- Web Manager;
- Social Media Manager;
- Internal Communications Manager;
- UK Communications and Innovations Officer;

- Press Office Manager;
- CERN Theoretical Physicist;
- Experimental Physicist working on the ATLAS experiment;

Observations with the CERN Communications Group were carried out over the participant's normal working day, 9am-5pm, observing and recording their routines. The CERN researchers however did not have such standard working days, often working at home/at evening and weekends. The theoretical physicist was observed at the CERN site from 11am-5pm, while the experimental physicists was on site from 10am-4pm. Where observations where not possible during out of hours work, this information was supplemented through the interviews carried out the following day.

As within the pilot study, an 'observer as participant' approach was initially adopted. However, on occasions with the Social Media Manager, Internal Communications Manager and the UK Communications and Innovations Officer, a 'participant observer role' was adopted when asked to review blog posts, articles and feedback on websites and surveys. Similar to Alder and Alder's (1987) description, this choice to play a more participatory role was a natural progression rather than an active decision. There were, however, pros and cons to this switch, especially in terms of the types and variety of information gathered during these times. While it provided access to additional documents, (draft blog posts and articles), and brought me closer to the actual practices of the participants, the danger was other activities could have been missed. Again, this issue was reduced through the use of interviews to recap specific events.

3.3.5.3 Ethnographic research process: Stage 5

While the results of ethnography can be presented in numerous ways, the use of narratives are one of the most common (Angrosino, 2007). Here, the use of narratives were designed to describe the setting, participants and activities observed during the ethnographic process. As Angrosino (2007) describes, narratives can take many forms, ranging from de-personalised, objective descriptions of events, to more creative, impressionistic, confessional styles. Yet, no matter the style, narratives should aim to create 'Thick Descriptions'[43], detailed accounts of what has been experienced (Denzin, 1989). Such thick descriptions also helps establish the credibility of the research through the contextualising of the sites, people and events studied (Creswell and Miller, 2000).

Observational data took the form of descriptive field notes, using an observation protocol focusing on the various activities of the participants (Appendix B). Where possible, products of participant's communications activities (Press Releases, Social Media posts, blog etc.) were collected for additional analysis. Summaries were written up directly after each observation, with an initial analysis carried out to identify issues for further investigation. Questions surrounding these issues were developed and came

[43] Thick description is discussed in more detail in Section 3.5.

to inform the interview protocols for the semi-structured interviews that followed the observations (Section 3.4.2).

Following the completion of all observations and interviews, detailed narratives of individual cases were created from the observation proforma and my initial summaries. These were later combined with relevant quotes and document analysis (outlined in Section 3.5 and reported in Chapter 5) to portray are comprehensive description of the events and activities observed within the individual case studies. Analysis of this data was theory driven in the first instance, applying central themes and key analytical frameworks (See Chapter 2) within the relevant case studies. For example, the activities of the various members of the Communications Group were compared with Fahy and Nisbet's (2011) typology of communication professionals to explore the roles of the various participants. A more inductive approach was used in the second instance, allowing any additional themes to emerge from the data. This often required the reviewing of additional literature to help draw out further themes and concepts from the data, this was the case with the identification of public relations functions within the group.

3.4 Semi-structured Interviews

As Stage and Mattson (2003) describes, in-depth interviewing can be a useful instrument when attempting to understand the unique experiences of those under study. Used in conjunction with observations, interviews can help clarify initial interpretations and further explore what has been observed. Gray (2004, pp.215-217) describes semi-structured interviews as:

> "…non-standardized, and are often used in qualitative analysis. The interviewer has a list of issues and questions to be covered, but may not deal with all of them in each interview. The order of questions may also change depending on what direction the interview takes. Indeed, additional questions may be asked, including some which are not anticipated at the start of the interview, as new issues arise. Responses will be documented by note-taking or possibly by tape-recording the interview. The semi-structured interview allows for probing of views and opinions where it is desirable for respondents to expand on their answers."

Spradley (1979) outlined the three elemental phases of the interview process: *explicit purpose, explicit explanations* and *ethnographic questions.* The first step, *explicit purpose*, involves briefing the participants as to the purpose of the interviews and the direction the interview is going to take. The second step, *explicit explanations*, involves detailing how the interview will proceed. This included outlining the questions that are going to be asked, explaining how the interview will be audio recorded and encouraging them to talk freely and openly and in their own words. Spradley's (1979) third element, *ethnographic questions,* are used to guide the interviews. These included 'Descriptive questions', made up of grand-tour and mini-tour questions (Spradley, 1979). Grand-tour questions require the participants to provide descriptions of the significant features being studied in their own words. These are followed by mini-tour questions that probe for more details in responses to the grand-tour questions.

3.4.1 Interview Process within the Pilot Study

Spradley's (1979) three elemental phases (outlined above) were used to inform the interview process for both the exploratory pilot study and more focused main study. Within the pilot study, eight-semi-structured interviews were carried out face to face with CERN media professionals and researchers involved with the communication of, and engagement with, High-Energy Physics. The aim of these exploratory interviews were to gain an initial overview of communication practices across CERN, and explore the relationships between the CERN Communications Group, CERN researchers and other media professionals associated with CERN. Participants comprised:

- CERN's Head of Communication/ Head of Press;
- ATLAS Outreach, Education and Communication Coordinator;
- CMS Education and Outreach Coordinator;
- Head of Education and Outreach for ALICE;
- Head of Education and Outreach for LHCb;
- Exhibition Developer;

- Experimental physicist working on the CMS experiment;
- Experimental physicist working on the ATLAS experiment.

Participants were sent invitations and information sheets ahead of the interviews, outlining the purpose of the interviews and the study more broadly (Appendix C). Interview protocols were designed ahead of time (Appendix D), allowing the interviews to be carried out in a systematic way, providing a procedural guide for carrying out each interview, as well as a list of questions that would be asked (Jacob and Furgerson, 2012). These protocols were not designed to provide a rigid structure, rather they provided a relatively informal order to the questions, allowing for responses in participant's own words. This semi-structured approach to interviews gave interviewees the time and scope to talk about their opinions through open-ended questions.

As the participants included communication and engagement professionals as well as physics researchers, three separate protocols were designed to explore the various practices associated with each group (Appendix D). These protocols helped fulfil Spradley's (1979) first step in the interview process, explicit purpose. Protocols contained an introductory script that briefed the participants as to the intended direction the interviews were going to take. Protocols also prompted the collection of informed consent from participants that explained how data would be gathered (audio recordings). How the data would be used was also outlined, explaining who it would be shared with (supervisors) and the extent of the anonymity they would be given in the data. Participants were also given the right to leave at this point.

The interview protocol also helped address the explicit purpose stage where the intended direction of the interview was explained. Explicit explanations were also provided at this stage. Participants were told the questions they were going to be asked and were encouraged to talk in their own words. Ethnographic questions were used to guide the interview. Questions were open-ended, encouraging detailed answers from participants. Basic, introductory questions were asked initially, followed by 'Grand-tour' questions that delved into deeper, more complicated issues. Mini-tour, probing questions followed these grand-tour questions, allowing for more detail to be gained from the participants responses.

3.4.2 Interview Process within the Main Study

With semi-structured interviews proving useful within the pilot study, this method was again used within the main study, this time asking more specific questions and in greater collaboration with the observations.

Interviews were carried out with all participants who took part in the focused observations (section 3.3.6.2). While the pilot study interviews were carried out with a wide range of participants involved in communications functions across CERN, the main study focused primarily on the Communications Group and the roles of the various members. This was supplemented by interviews with CERN researchers to gain an external perspective on communications. A similar procedure was used within the main study as with the pilot study, this time however focusing on more specific issues, such as organisation and the use of technology for working and communication practices.

Interviews were carried out face-to-face with the participants after an initial review of the observational data had been carried out. Separate protocols were developed ahead of the interviews based on questions or issues raised during the participant's observational day (Appendix D). This allowed for a more focused interview to be carried out, specific to each participant.

3.4.3 Analysis of Interview Data

Once recorded, all interviews were transcribed in full by the researcher ahead of analysis. The practice of transcribing recorded data is a central activity of qualitative research, and as such should not be overlooked within the research process. Ochs (1979) describes how transcription is a selective process that reflects the theoretical goals of the individual study it is being used in. Transcription requires the translation or transformation of sounds/ images to text (Duranti, 2007), through a selective process by which the researcher chooses which features of language and interactions are transcribed. As a result, it is important to acknowledge what features of the recorded interactions have been selected and the reason for their selection (see below). Overall, transcription can provide an accurate record of data in an easily accessible format (Silverman, 1993) while also allowing for deep immersion in the data.

As Halcomb and Davidson, (2006) describes, the underlying methodological approach of a study can affect how interviews are carried out and how they are transcribed. Halcomb and Davidson (2006) outlines how a mixed methods study, such as this, that seeks to identify themes and ideas from its data, may not require verbatim transcriptions. Instead, the transcription process should be more focused towards the interpretation and generation of meaning in what's being said. Within this thesis, denaturalised transcripts were produced (Oliver *et al.*, 2005), whereby idiosyncratic elements of speech were removed. This made the process of analysis and eliciting meaning from the data easier. Once transcribed, thematic analysis was carried out on each transcript. This was first done individually, with data later being combined to provide a broader overview of the research area.

As Guest *et al.* (2012) describe, thematic analysis moves beyond counting words or phrases, instead focuses on identifying and describing the implicit and explicit themes within the data. Such an approach requires greater involvement and interpretation on the part of the researcher. While thematic analysis allows you to capture the meaning within textual data, there are a few issues surrounding interpretation in defining themes and applying themes to segments of the text. In order to minimise such issues, it is often recommended that others check interpretations, such as other academics and stakeholders. Such measures can help maintain/improve the reliability of the analysis.

The full analysis of the interviews used both a theoretical and inductive approach to thematic analysis, allowing themes to emerge from the data and from theoretical themes of the thesis. In doing so, theoretical frameworks of the thesis were used as an initial lens to review the data, including Keyton’s (2005) pyramid model of organisational culture, Fahy and Nisbet’s (2011) typology of media professionals and Borchelt and Neilson’s (2014) levels of public relations. Further work was then drawn on to identify, select and isolate other themes and concepts from the data:

> “ […] in a process of working through the articles systematically and employing open, axial and selective coding of the items one is looking for”
>
> (Flick, 2006, p.296)

Within open coding, categories and themes are developed based on the data in an inductive process that involves the interpretative work of the researcher (Flick, 2006; Silverman, 2005). In axial coding, connections between these themes and categories are created, with selective coding providing example passages that illustrate the categories and concepts identified.

To manage the data, the qualitative data analysis tool NVIVO was used to help in the analysis. While much of the analysis was carried out manually, the use of Computer Assisted Qualitative Data Analysis Software (CAQDAS) helped produce an accurate and transparent analysis process. The use of such software makes the searching and categorising of text quicker and allows for easier integration of various data sets, key for the cross case analysis (Section 3.5). However, some fear CAQDAS can distance the researcher from data (Barry, 1998). As such, the use of manual analysis of the transcripts along with NVIVO helped me stay close to the data while making organisation easier. From this, selected quotes, relevant to specific moments within the observations, could be combined with field notes to form the narrative accounts of the participant's working day (Chapter 5). Further quotes were then used within the cross-case analysis, allowing for more data to appear in the thesis.

3.5 Analysis Across Methods

While each data strand was initially analysed separately, they were all combined using thick description. As Mills (1959) suggests, tools of analysis are needed that allow everyday life to be understood in terms of theoretical frameworks. Here, Mills (1959) argues it's difficult for actors to perceive social situations and practices from another perspective. It is therefore up to researchers to analyse and make meaning from the 'ordinary'. As such, researchers should make use of various perspectives and frameworks to build a clear picture of the research area.

Within this thesis, the principles of 'Sociological Imagination' (Mills, 1959) was applied through the use of thick description to produce narrative accounts of each participant within the main study, using the particular theoretical lenses underpinning this research (Chapter 2). Thick description, a concept developed by Geertz (1973) and originating with Ryle (1949), aims to detail the context in which interpretations of data are carried out. Denzin (1989, p.83) expanded on the notion of thick description developed by Geertz (1973), noting:

> "A thick description […] does more than record what a person is doing. It goes beyond mere fact and surface appearances. It presents detail, context, emotion, and the webs of social relationships that join persons to one another. […] It establishes the significance of an experience, or the sequence of events, for the person or persons in question. In thick description, the voices, feelings, actions, and meanings of interacting individuals are heard."

Thick descriptions, therefore, can be used to place social actions into the context in which the action took place. This is fundamental within this research at CERN, allowing the associated practices of the members of the Communications Group to be placed within the context of the group and CERN as a whole. Thick description of social practices can also promote 'thick interpretation' of these practices, which leads to a 'thick meaning' of results.

As described in Section 3.3.5.3 these thick descriptions detailed the locations observed and the people within them. By combining the ethnographic observations with the interview data within these thick descriptions, the observed practices of the Communications Group could be accurately described, while the interviews provided an insight into the thoughts and feelings of those carrying out those practices. This helped to assign meaning and purpose to the practices. These thick descriptions are reported in Chapter 5.

3.6 Conclusion

This Chapter has described the mixed methods approach used in this thesis, how it was developed, and the rationale behind it. With the overall goal of this research aiming to examine how CERN's research becomes public in the digital age, achieved through the 13 Sub-Questions outlined in Chapter 2, Section 2.6, a suitable methodological approach was needed that enabled multiple facets of the research area to be explored.

With no set approach for the researching of Communications Groups within scientific organisations uncovered through the literature review, this study drew on other fields, specifically studies into other communication professionals, such as journalists working in online newsrooms. The likes of Lawson-Borders (2003) and Boczkowski (2004) utilized mixed methods to explore technology use in online newsrooms, while others such as Domingo (2003), Paterson and Domingo (2008) and Coleman (2010) promote the virtues of ethnographic techniques in particular to study such cultural produces. As Schlesinger (1980) describes, ethnographic methods can make basic information about working practices of communication professionals available through systematic observation of their social practices. Continued research into the use of ethnography reinforced its suitability, especially when little is known about particular groups or individuals, as is the case within this thesis.

Within the pilot study, observations were used to gain an overview of the research area. Exploratory, unstructured observations were carried out with a broad range of communication professionals at CERN. While providing an initial insight, this approach provided a great deal of data that became hard to manage. Within the main study, this issue was addressed by focusing observations around the particular activities of the Communications Group, with an external perspective provided by observations with two CERN researchers.

Along with ethnographically informed observations, interviews became an important part of the mixed methods approach. As Stage and Mattson (2003) describes, in-depth interviewing can be a useful instrument when attempting to understand the unique experiences of those under study. Within the main study, semi-structured interviews were used in conjunction with observations to help clarify initial interpretations and further explore what had been observed.

Document analysis formed a key part of both the main and pilot study. Within the pilot study, document analysis was used in an exploratory manner, providing an initial insight into the research area and helping identify areas for further research. In the main study, document analysis became more focused, being used to complement other data streams.

The use of multiple methods in this sequential and complementary way allowed numerous Sub-Questions to be explored throughout the study. The contribution of these methods to each Sub-Question has been outline in Table 3.3.

Table 3.3: Research methods used to explore each Sub-Question

Sub-Question	**Primary Research Method**
1. *How does CERN's Adhocracy organisation impact on communication practices and openness?*	Document Analysis and Interviews
2. *How does CERN's communications architecture impact on communication practices and openness?*	Document Analysis and Interviews
3. *Where does the CERN Communications Group sit within the organisation?*	Document Analysis
4. *How does the nature of the work carried out at CERN impact on the function of the Communications Group?*	Observations and Interviews
5. *Do CERN communication professionals require scientific backgrounds?* • *How does their background impact their working practices?*	Interviews
6. *How does the nature of the work carried out at CERN impact on openness?*	Document Analysis and Interviews
7. *How have digital technologies impacted on the communication practices of researchers and communication professionals working at CERN?*	Observations and Interviews
8. *How are digital technologies used for engagement purposes by CERN researchers and professionals?*	Observations and Interviews
9. *What factors influence the use of digital technologies?*	Interviews
10. *Who have CERN identified as key stakeholders?*	Document Analysis
11. *What is the role of the CERN Communications Group in reaching these stakeholders?* • *What routine activities do the group undertake?*	Document Analysis, Observations and Interviews

12. Where does the CERN Communications group sit within the process of mediation of scientific information?	Document Analysis, Observations and Interviews
13. What is the role of scientific public relations in the Circuit of Mass Communication?	Observations and Interviews

Chapter 4 Pilot Study

This chapter outlines the results of an initial pilot study, carried out in November 2012, involving actors with various communications and public engagement roles at CERN. The pilot study consisted of eight semi-structured interviews, observations at a number of meetings and analysis of strategic documentation regarding communication and engagement at CERN (outlined in Chapter 3, Section 3.1). The pilot study was designed to address a number of key issues. Those being:

- To map the research literature alongside strategic documentation and activities at CERN with a view to identifying gaps in knowledge and areas for further study;
- To explore possible methodologies and methods for data collection and analysis;
- To trace the development of CERN's 2012-2016 Communications Strategy (CERN, 2011).

4.1 CERN's Developing Communication Strategy

Through desk-top research, a number of relevant documents regarding strategies for communications and public engagement at CERN were identified. Using the CERN 2012-2016 Communications Strategy (CERN, 2011) as a starting point, online searches identified three other communication strategies from 1992, 2006 (CERN, 2006) and 2009 (CERN, 2008). These documents provide a useful baseline for tracking the development of the current 2012-2016 strategy (CERN, 2011). By analysing these documents in terms of their commitment to engagement, outlined strategies, key messages and mandated audiences, the values and cultures that underpin communications and public engagement at CERN could be traced, examining how they developed. Such communication artefacts are an important aspect of Keyton's (2005) *basic* element of organisational culture (for a discussion see Chapter 2, Section 2.2). As Goodman (1998) describes, mission statements and key messages help employees gain a better understanding of what an organisation stands for. As such, analysis of these *basic* element artefacts is crucial for establishing how CERN researchers and professionals see the organisation and their role.

Across these strategies, changes can be seen as CERN and the LHC itself moved from its construction phase to its operating phase. CERN's earliest communication plan dates back to 1992, some 38 years after CERN was established. Yet it was never implemented across CERN. It wasn't until 2005 that a Communications Plan was developed, being approved in 2007 (CERN, 2006). During this time, communication activities were carried out ad hoc, as the Head of Communications describes.

> "There was no planning document for communications between then [1992] and about 2005. We just did things and we just communicated without actually having any overall plan. So in 2005 I sat down with my team and we wrote a plan."
>
> (Head of Communications, interview 22.11.12)

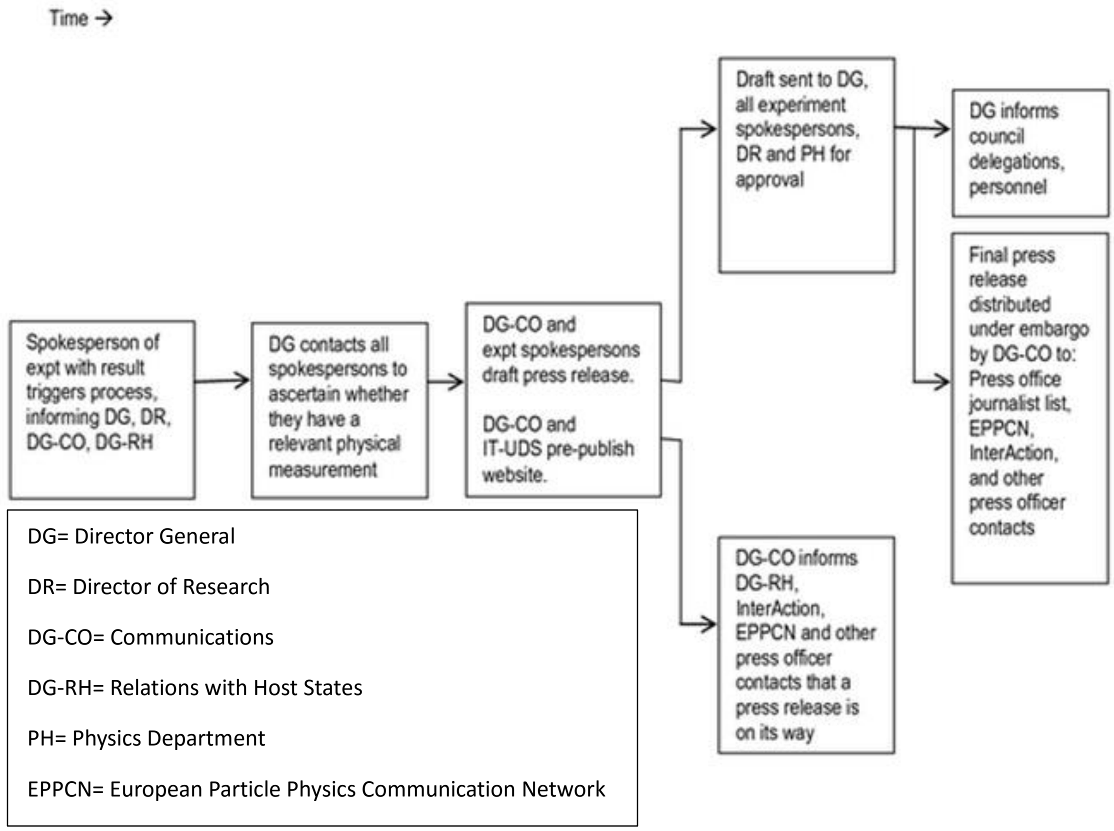
The priority of the 2006 Communication Plan was to gain maximum coverage for CERN through the communications opportunities afforded by the start-up of the LHC (in 2007), and establish CERN and the LHC as a brand. The plan aimed to ensure harmony between the various actors involved in the communication of the LHC, including CERN's Communication and Education Group, IT Communications, CERN Member States and each of the LHC experiments. The desire was to raise awareness of the LHC prior to its launch, particularly amongst news media professionals, and to sustain the interest throughout its operation. Yet, as the Head of Communications described during the interview, it was hard to achieve many of these aims at this time, with the Communications Group effectively becoming the Director General's personal communications unit, with little awareness as to the role of communications across the rest of CERN. Despite this, the first beam from the LHC achieved a great deal of coverage, with 300+ journalists on site and parallel events being held across CERN Member States and in other High-Energy Physics labs around the world.

CERN's next Communications Plan, 2009 – 2013 (CERN, 2008), was more detailed and aimed to build on the coverage and awareness from the LHC start up during the LHC's repair and restart. The primary focus in this period would shift from the first beams to the new physics, with large-scale media events saved for particular milestones of first collisions and first results. The intended process for the communication of information coming from the LHC, including technical problems/accidents leading to delays, as well as results and discoveries, are described. As this 2009-2013 Communications Plan

(CERN, 2008) outlines, when it comes to physics results, announcements would be accompanied by a scientific seminar, making it clear that the scientific community should be made aware of important physics announcements before the media. In this respect, openness and the timing of openness is built into CERN's strategy. The use of embargoes are therefore crucial, making sure the media withhold information about the discovery until after the scientific seminar, allowing information release to be coordinated simultaneously. The full procedure for releasing of results is outlined in Figure 4.1.

This procedure, while represented as a neat linear process, is not as straightforward as it seems, with thousands of individual researchers with access to technologies, particularly social media that could facilitate the early release of information. To combat this, the Communications Group requested that this procedure be circulated within each experimental collaboration to reduce the chance of leaks from individual physicists. This was accompanied by experimental guidelines on blogging and use of Web 2.0 technologies. The 2009-2013 Communications Plan includes the CMS guidelines on blogging, which breaks down issues on blogging into three categories; scientific, internal and private (CERN, 2008). Within the scientific category, the guidelines make it clear that individuals should not discuss results until they have been approved.

Figure 4.1: Communication flow prior to release to the media (CERN, 2008).



> "Nothing should be discussed or shown that has not yet been approved. Furthermore, bloggers should kindly refrain from posting discussions on just-approved CMS results until the collaboration has officially presented them first."
>
> (CERN, 2008, p.48)

Similarly, the guidelines describe how individuals should not discuss any internal matters (i.e. operational issues, procedures and private meetings) on blogs (CERN, 2008). This helps to maintain the competitive nature of the collaborations. As the Head of

Communications describes, these guidelines were brought in by the experiments after a particular incident with a blogger from Fermilab[44] in 2005.

> "The experiments have their own guidelines [for blogging], and this was triggered by a particular blogger […] He started blogging things that were not mature and his collaboration wasn't ready for him to release them, so they weren't considered to be mature results. He was just blogging the discussions that were happening and shouldn't have got out, and these got picked up and reported as fact by New Scientist I think it was. So that led to the introduction of guidelines in all the experiments."
>
> (Head of Communications, interview 22.11.12)

While these guidelines are in place, there is no indication as to the consequences of breaking these guidelines.

The current 2012-2016 Communications Strategy (CERN, 2011) on the other hand has a greater focus on capitalising on CERN's visibility to generate and sustain political, financial support for CERN (CERN, 2011). This strategy is the first to really outline how communications could engage with and benefit many aspects of society (See Section 4.1.2). Furthermore, this strategy outlines a number of issues the Communications

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[44] Fermilab: American particle physics and accelerator laboratory, http://www.fnal.gov/, last accessed 20.01.16.

Group faces in terms of lack of funding for communications activities (CERN, 2011, p.2), improper communications structure and a poorly understood mission statement. These issues identified through the analysis of this document became a central part of the main study.

4.1.1 CERN's Changing Messages

Over the past ten years, the evolution of communications at CERN has been clear with the development of these communication plans and strategies. As the focus of the communications functions shifted from establishing CERN as a branding in 2005, to formalising internal communications mechanisms in 2009, to the current attempts to unite communications functions across the organisation, variations in key messages have been seen. As described in Section 4.1, such messages and corresponding mission statements are an important aspect of Keyton's (2005) *basic* element of organisational culture.

In 2005, four key messages were outlined in the Communications Plan, those being:

- CERN is a world-leading laboratory for research and discovery in fundamental physics;
- CERN provides a valuable role in science communication, education and training;

- CERN and the wider particle physics community develop technology for the future;
- CERN and the wider particle physics community promote peaceful collaboration between nations.

In the 2009 Communications Plan, six key messages were outlined:

- Fundamental science satisfies the basic human instinct to explore;
- Fundamental science is a driving force for technical innovation, collaboration and scientific education: without fundamental science, there is no science to apply;
- CERN is a world leader in fundamental research;
- The LHC will launch a new era of discovery and understanding of fundamental questions about the Universe;
- LHC technologies create benefits for society;
- CERN and the LHC are excellent examples of science transcending barriers of age, religions, gender and nationality.

Yet across these two Communications Plans, there is no indication as to how these messages will be transmitted, to which audiences they are aimed and how success would be measured. In contrast, the 2012-2016 Communications Strategy (CERN, 2011) outlines similar key messages, this time with clear examples of how they are achieved.

This strategy also clearly outlines CERN's Mission Statement, something that was otherwise missing from the previous Communications Plans.

As outlined in the CERN's 2012-2016 Communication Strategy (CERN, 2011), CERN's mission statement was not well known within CERN itself and within the wider public. This was also demonstrated by a Communication and Stakeholder's Engagement Survey carried out in 2012. As result, the 2012-2016 strategy aimed to create a clearer and more concise mission statement. This became:

> 'CERN exists to understand the mystery of nature for the benefit of humankind.'

This change to a simpler mission statement was designed to give a clearer and easier explanation as to what CERN is, what it does and what it stands for. It also formed the basis of three strategic themes, 'discovery by science', 'innovation through technology' and 'diversity in people', that aim to guide every professional conversation about CERN. Such clearly defined messages and mission statement could therefore help CERN achieve at Keyton's (2011) *basic* element. Yet, with the 2012-2016 Communication Strategy (CERN, 2011) still to be fully implemented by CERN management, such benefits have not yet been realised fully.

4.1.2 Increasing Audiences

Along with the mission statement and key messages, the 2012-2016 Communications Strategy (CERN, 2011) also develops and further distinguishes their intended audiences, more so then the previous Communications Plans. CERN's 1954 Convention (Amaldi,

1955) outlines in Article II.1 and II.3 their two mandated audiences, the High-Energy Physics community and CERN's Member states:

> Article II.1 "The Organization shall provide for collaboration among European States in nuclear research of a pure scientific and fundamental character, and in research essentially related thereto. The Organization shall have no concern with work for military requirements and the results of its experimental and theoretical work shall be published or otherwise made generally available."
>
> (Amaldi, 1955, p.4)

> Article II.3 (c) "….CERN shall organise and sponsor international co-operation in nuclear research, including cooperation outside the laboratory, promoting contacts between scientists and interchange with other laboratories and institutes."
>
> (Amaldi, 1955, p.5)

While this statement does not specifically refer to openness, it's clear how such ideas could develop within the organisation. With collaborative practices and dissemination of results mandated within the Convention (Amaldi, 1955), a culture of openness has been well established at CERN. Yet, how this is enacted is not clear within the Convention (Amaldi, 1955).

While the CERN Convention (Amaldi, 1955) only mandates for two audiences, the 2006 Communication Plan identified seven further ‘key target audiences’ (CERN, 2006). These were:

- The general public
- The physics community
- Science and technology decision makers
- Industry
- The CERN community
- Schools
- Local community

In the 2009 Communications Plan (CERN, 2008), similar broad target audiences were outlined, those being:

- Science and technology opinion formers;
- The CERN Community (including scientific, administrative and professional staff, contractors working on site and users);
- The local community;
- The broader scientific community;

- Media;
- Educational Systems, primarily high school level;
- The general public.

In the 2012-2016 strategy (CERN, 2011), 11 target audiences were outlined, this time with the desired strategic outcomes of the communications made clear.

1. The CERN Community: Develop a sense of belonging and foster an appreciation of the importance of strategic communications;
2. The General Public: Generate trust in and develop advocacy for CERN;
3. The Local Community: Engage in dialogue. Develop trust and advocacy as well as provide access to information of relevance to CERN's neighbours. Promote the benefits of CERN's presence in the area;
4. The Media: To be an authoritative, timely and open source of information about CERN and particle physics;
5. Potential Sponsors: Increase private financial contributions for CERN's non-core activities;
6. Alumni: Develop and maintain a network of ambassadors;

7. Educational Systems: Develop knowledge of CERN's research and physics. Develop an understanding of benefits of research to society and promote physics and science as a career choice;
8. The Cultural and Artistic Community: Engage with the arts. Collaborate with cultural entities and artists. Protect CERN's brand and the integrity of CERN's content;
9. Younger Children: Generate basic awareness of CERN's research and its broad purpose. Generate interest in basic science and scientific method. Inspire young people to develop a passion for learning and discovery;
10. Industry: Generate awareness that CERN is an organisation that companies of all sizes can do business;
11. Job Seekers: Generate awareness of the range of opportunities available at CERN. Position CERN as a great place to work.

All of these audiences are strategically important groups for the Communications Group to engage with. As Borchelt and Neilson (2014) describe, interacting with such stakeholders is crucial in order to gain, maintain and repair relationships between these actors and the organisation. The 2012 -2016 Communications Strategy (CERN, 2011) is the first to go some way to outline some of the public relations activities aimed at these groups (Table 4.1).

Table 4.1. Audience/ activity matrix (adapted from CERN Communications Strategy 2012-2016, CERN, 2011).

Community → **Activity ↓**	**1.CERN**	**2.Public**	**3.Local**	**4.Media**	**5.Sponsors**	**6.Alumni**	**7.Edu**	**8.Culture**	**9.Kids**	**10.Industry**	**11.Job seekers**
Website	+	+	+	+	+	+	+	+	+	+	+
Social media		+		+							+
Spokesperson		+		+							
Press Office		+		+				+			
CERN Courier	+			+						+	
Internal Comms	+										
Brochures		+	+	+	+	+	+		+	+	+
Annual Report	+	+		+	+	+		+			
Photo/ Video	+	+	+	+			+		+	+	+
Graphic design	+	+	+	+	+	+	+	+	+	+	+
Events		+	+	+	+	+	+	+	+	+	+
Exhibitions	+	+	+				+	+	+	+	+
Newsletters					+	+					
Corporate info support	+	+	+	+	+	+	+	+	+	+	+
Copy editing	+	+	+	+	+	+	+	+	+	+	+
Translation	+	+		+	+	+	+	+	+	+	+

The various activities outlined in Table 4.1 are at the core of the groups ‘trust portfolio’ (Borchelt and Neilson, 2014) and their individual *Programme* level components (See Chapter 2, Section 2.4.5). This provides a useful basis line for tracing and evaluating the public relations functions carried out by the Communications Group.

As Table 4.1 shows, the media are one of the best catered for audiences, with the majority of activities aimed at this group. Similarly, Kallfass (2009) found a great deal of scientific public relations practitioner’s time is spent cultivating contacts in the media, including providing Press Releases and background material to journalists. The focus on the media in this way may well justify their importance of this actor within the Circuit of Mass Communication (Miller *et al.*, 1998).

The significance of this relationship with the media was also demonstrated during the interview with the Head of Communications:

> IV: “Would you say there’s an audience you target more than others?”
>
> HC: “The media. […] We put a lot of effort into journalists, I mean both through Press Releases and through site visits and setting up events for them as well as just briefing them. So, you know, in the lead up to big events I will phone many, many journalists and talk to many, many journalists about this, what’s coming up, so that they can get, they have time to get their stories right. […] There are a number of journalists who I know extremely well and, you know, I’ve been doing this job for years and some of them change quickly and some of

them don’t. So there are people who I speak to quite regularly about what’s happening here and will tell them things on and off the record as necessary and can trust them absolutely implicitly not to do anything with that information.”

(Head of Communications, interview 22.11.12)

As Blobaum (2014) explains, trust plays an important role in the various relationships between journalists and the individuals and organisations outside of journalism. As the Head of Communications describes, the relationships he has built with various journalists over the years means he can trusts them with otherwise sensitive information.

Along with the media, another group that the Communications Group works closely with are the various physics institutes around the world. As the Head of Communications describes, this relationship is important not just for CERN, but for particle physics as a whole.

“We all recognise, I think, the communications people in the labs, that we are stronger together and that we are, we all do depend on each other. So even though CERN is particularly strong in the particle physics world at the moment, I don’t take it for granted that will always be that way. I think it’s vital for CERN’s

> future prosperity that particle physics thrives in the United States as well; if it dies in one region it could easily die in another, so we work well together."
>
> (Head of Communications, interview 22.11.12)

The importance of these relationships became apparent during the observations at the InterAction and EPPCN/IPPOG meetings, which involved the heads of communications for the top physics labs in the world, funding agencies in CERN Member States and communicators for the LHC experiments. It was clear across both meetings the importance of the various physics bodies working together, and the benefits such relationships can bring. For example, with the 4th of July 2012, Higgs update, this relationship was crucial for the various laboratories and institutions, who relied on the CERN Communications Group, and the Press Office in particular, to provide them with information surrounding the event ahead of time. During the meetings, representatives from the UK, Germany and the Netherlands expressed the benefits of their relationship with the Communications Group. As the UK representative described during their presentation:

> "Work with [CERNS's Head of Communication], always. If we didn't know what they were doing, and they didn't know what we were doing, it would have been a mess. […] We couldn't have done it without them."
>
> (UK representative at EPPCN/IPPOG meeting, 30.11.12)

Working with the CERN Communications Group in advance allowed these representatives to plan media events, brief local and national journalists, prepare their own Press Releases and acquire quotes from researchers in their own institutes. As such, these events also help gain greater coverage for CERN and the work carried out there. This also demonstrates the role of the CERN Communications Group outside of CERN, as part of a broader, transnational network of research institutions.

Much like the relationship with journalists, the Communications Group has to trust that information shared with these external communications groups will not be released ahead of time. As outlined in the 2009-2013 Communications Plan (CERN, 2008), the procedure at CERN for communicating results involves feeding back to the scientific community before being released to the public. As such, with the 4th of July 2012 Higgs update, the scientific conference held at CERN, as part of International Conference on High-Energy Physics[45] in Melbourne, was to be the first confirmation of their findings, made to the physics community. Press Releases and other 'information subsidies' (Gandy, 1982) were effectively under embargo at this point. Only after this conference were any Press Releases permitted to go live. As Kiernan (1997) outlines, the use of embargoes in this way allows for greater coordination of information and its release. This does however, require all those involved to follow the plan. If somebody was to

[45] International Conference on High Energy Physics, ICHEP, http://ichep2014.es/, last accessed 19.01.2016.

break this embargo, this could cause problems from those who have otherwise stuck with it. Such breaking of embargoes has occurred within the sciences, for example, with NASA'S life on Mars announcement (Holliman, 2000). This was also the case with the 4th of July 2012 Higgs update.

With the science seminar scheduled to take place at 8.00am, GMT, and the announcement to be made closer to 9.00am, the UK representative wanted to make sure the information was out there to make it onto the breakfast news within that window. As a result, they decided to release the information in the UK before the science seminar had finished, during the embargo period.

> "We had a fundamental question at the very beginning, do we sit and wait for the seminar to finish, knowing full well what is going to be said, or do we say this is a media event and get someone to say "what they are about to tell you is this" […] So we cheated, but we told CERN we were going to cheat and we had a very careful consideration with the physics groups as well."
>
> (UK representative at EPPCN/IPPOG meeting, 30.11.12)

This, in turn, caused issues with reporting in other Member States. Representatives from both Finland and Norway reported that media outlets in their countries picked up the UK reporting of the event, instead of their own. This is a real challenge when it comes to the reporting of a transnational event, with local requirements challenging attempts at a coordinated release of information. As CERN's Head of Communications describes, such an event can also put strains on relationships with other media professionals.

> "As [the UK representative] said, they cheated, they announced it before we did. That caused problems for other people. It meant they couldn't tell their story the way they wanted. […] One journalist said 'It was great, but it was a mess because we played the game, we respected your embargo, and it was very frustrating to see this spoken about everywhere else before we were allowed to say anything'."
>
> (Head of Communications at EPPCN/IPPOG meeting, 30.11.12)

Further tensions were apparent during the discussion between researchers from the collaborations and the representatives from the member states. The main problem being CERN's desire to announce to the scientific community before the media, as outlined in the 2009-2013 Communications Plan (CERN, 2008). This issue came to a head at the EPPCN/IPPOG meeting, during a discussion between the UK representative and a CMS researcher:

> UK representative: "If you have a 45 minute seminar building up to an announcement, the media hate you."
>
> CMS Researcher: "We've been working in CMS for 20 years building up to that announcement, I don't think the media can complain."
>
> (EPPCN/IPPOG meeting, 30.11.12)

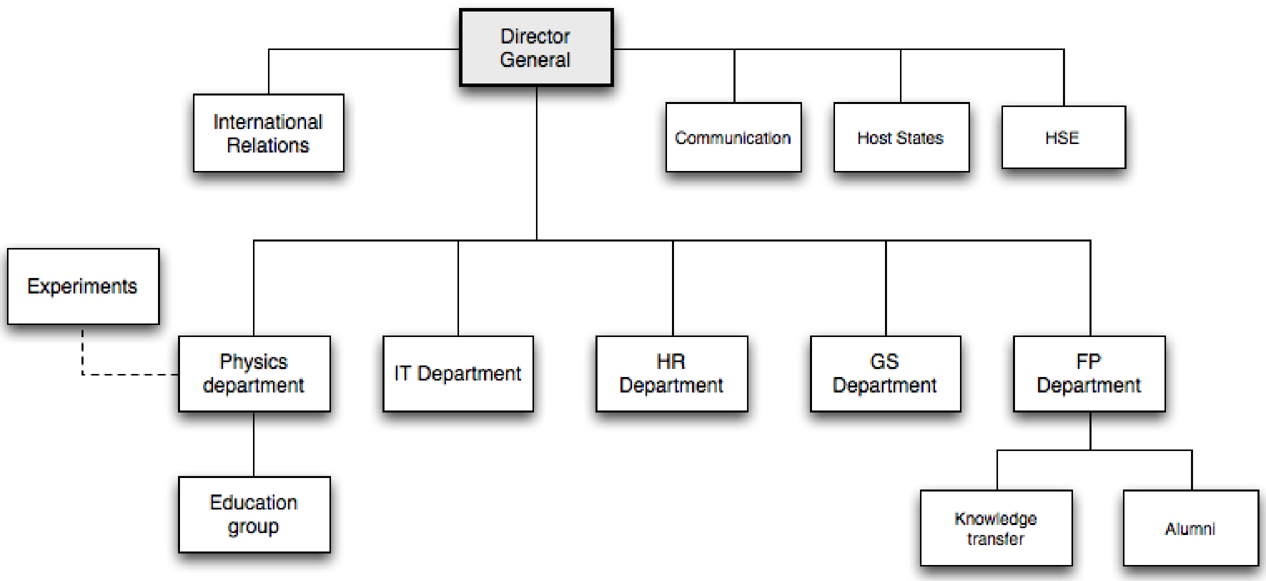
Overall, document analysis, along with attendance at the EPPCN/IPPOG and InterActions meetings, provided an extremely useful insight into the relationships the CERN Communications Group has with a number of their stakeholders. The observations in particular added a great deal to the pilot study, allowing the researcher to see how practices are enacted and some of the issues facing the Communications Group. Yet, the majority of examples were focused around the working of the Communications Group during a 'heightened state', where communication activities were more frequent. One aim of the main study therefore was to observe the Communications Group in an otherwise 'steady state', and the continuous activities aimed at these stakeholders.

4.2 CERN's Communication Organisation

The pilot study was particularly useful in gaining an insight into the organisation of CERN and their communications architecture. As Knorr-Cetina (1999) described (Chapter 2, Section 2.2), the organisation of CERN and the experiments resembles a 'post-traditional communitarian structure', with distributed responsibility and authority. Such a structure can in turn cause issues when it comes to communications. Hoogervorst (2004) further argues that the structure and culture of an organisation will effect the way its members communicate, both internally and externally. As such, part of the pilot study aimed to identify the organisation of not just CERN, but the Communications Group itself.

As CERN's 2012-2016 Communications Strategy (CERN, 2011) outlines, the organisation lacks an overall communications policy applied across the organisation, made difficult by the 'post-traditional communitarian structure' (Knorr-Cetina, 1999) and 'Adhocracy' (Mintzberg and McHugh, 1985) organisation of the experiments. This is summarised in Figure 4.2. As Figure 4.2 shows, CERN has an extremely decentralised communications architecture with several departments and experiments, all with their own independent communications functions, often following different agendas.

Figure 4.2: Organisation of Communication at CERN (CERN, 2011).



As outlined in Chapter 2, Section 2.2.1, such decentralisation of communications functions can provide greater flexibility and allow timely responses to events as they arise. Yet it is harder to coordinate communications at a strategic level, with multiple lines of communication needed across the various units. This decentralisation, and some of the issues coming from it, were recognised by a number of interview participants, including the Education and Outreach Coordinator for CMS, the CMS researcher and CERN's Head of Communications.

> "CERN is in itself a rather decentralised institution, if you want. So for instance, I don't work for CERN, I work at CERN. I think that's the case for the majority of people who are here, right. So, and in particular researchers, physicists, there are very few who are employed by CERN."
>
> (CMS Researcher, interview 16.11.12)

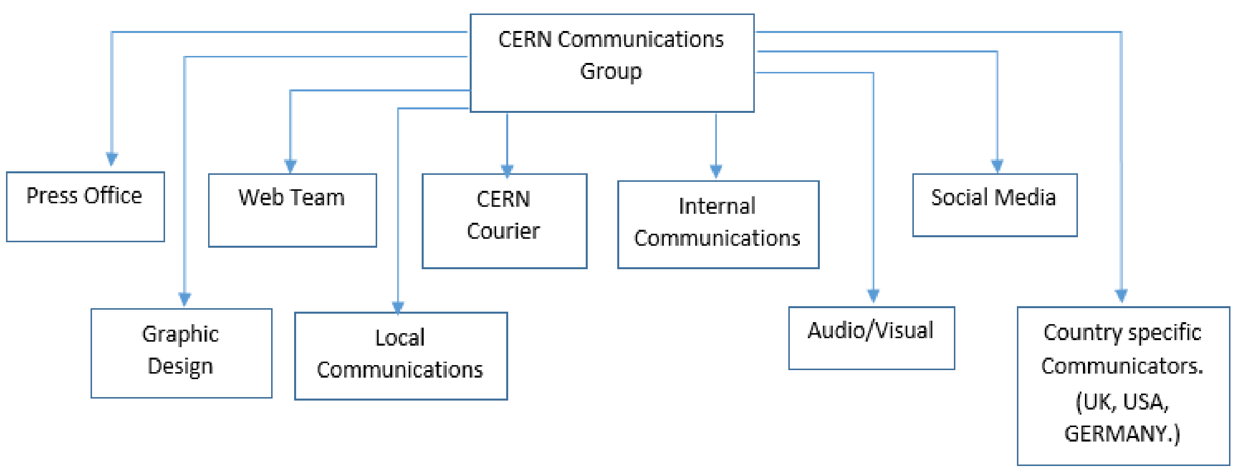
> "There's not a real organisation that encompasses what you'd call CERN and what you'd call the experiment and so on, and that is really painful, actually. So, a lot of the time, the biggest communications issues we have are between the Communications Groups of CERN and the experiments, which is a real shame, but that's the way it is. So there are things that go on in the CERN Group that do affect what the experiments do, that you only hear about at the very last minute and vice versa […]. There's also, not a very clear structure at CERN or in the CERN Group, itself, because you've got the Education group, you've got the Visits Service, you've got the Press Office. [...] There's, some things missing at a basic level, that if you improved them, they could make life a lot easier for everybody involved, because there's a lot of reinvention of the wheel."
>
> (CMS Education and Outreach Coordinator, interview 23.11.12)

"The real challenges are that CERN is, hierarchically, very horizontal, so anyone can communicate on behalf of CERN, and people do. So keeping, making sure that we're presenting a coherent message is always a challenge and will remain a challenge; I don't see that changing, it's just the nature of a big, globally distributed academic institution."

(Head of Communications, interview 22.11.2012)

Along with this decentralisation of communications functions across CERN, it became clear through the observations and interviews that the Communications Group itself is a rather separated team, made up of various sub units who predominantly work independently of each other. The structure of the CERN Communications Group is represented in Figure 4.3.

Figure 4.3: Organisation of the CERN Communications Group.



As the Head of Communications describes, this organisation has created issues when it comes to communications across the group. Here, this decentralised organisation of the Communications Group prevents effective sharing of information across the various members of the group.

> "We've, for years, been in the mind-set that we have a '*Bulletin'* silo and a 'Press Office' silo and a '*CERN Courier'* silo and now I'm trying to make it more, change the structure so that we have a creative team and a commissioning team. Basically, that's where we'll go and we're getting there. […] We have a news planning meeting where people are supposed to come along saying 'I'm aware of these stories', and we discuss and allocate the stories to audiences. But, you know, people come along and say 'the Bulletin is going to publish X', or 'the *CERN Courier* will publish X'. It's just a question of habit, so we're moving away from it."
>
> (Head of Communications, interview 22.11.12)

As a result, the separations of communications functions across CERN, and across the Communications Group itself, could lead to a breakdown at Keyton's (2011) second level of organisational culture, the *process* element. Here, the various units and teams involved in communications activities makes the sharing of information in upward, downward and horizontal directions difficult, with numerous channels required. This may well lead to issues at Keyton's (2011) third level, the *subjective* element, and the inter-relationships throughout the organisation, including levels of trust and cohesion. In order to explore these issues, further research is needed into the how the organisation of the Communications Group is effecting its members.

4.3 Conclusion

Overall, the pilot study provided a useful insight into the research area, helping to identify numerous areas for further research. In particular, findings from the pilot study provided an initial insight into communications and public relations activities carried out by the CERN Communications Group. While document analysis helped to identify CERN's target audiences and the activities aimed at them, the observations and interviews allowed this to be further explored in practice. The observations in particular demonstrated the importance of the Communications Groups relationship with external media professionals, scientific institutions and funding agencies, key actors in the Circuit of Mass Communication (Miller *et al.*, 1998). Yet the diversity of audiences identified within the document analysis goes far beyond the four actors within the Circuit of Mass Communication (Miller *et al.*, 1998). As such, there is space to revisit this model in the context of CERN and HEP, as well as in the digital age, to explore the interactions between the Communications Group and these various actors in the dissemination of scientific information.

Along with this insight into the Communications Group's audiences and related public relations practices, the pilot study also provided an insight into the impact of CERN's

‘Adhocracy’ (Mintzberg and McHugh, 1985) organisation on the ability of the Communications Group to carry out their functions. Using Keyton’s (2011) levels of organisation culture, a number of potential breakdowns at the first and second levels were identified, mainly due to the decentralised nature of communications activities across CERN and across the Communications Group. Here, the numerous lines of communication between the various teams and sub-teams involved with communications made it difficult to coordinate communications at a strategic level, creating tensions between the numerous actors involved. Once again, the main study aimed to explore these issues further, outlined in Chapter 7.

This chapter has also touched on certain aspects of openness at CERN, specifically the importance of the timing of openness. With the CERN Convention (Amaldi, 1955) calling for results to be made generally available, it is easy to see how a culture of openness could develop. The Communications Group plays a central role in this process, coordinating the release of data across multiple channels and to multiple audiences. The procedure for releasing information, outlined in the 2009 Communications Plan, makes it clear that the scientific community will be informed before the media and wider audiences. As such, the timing of openness is built into strategic documentation, aiming to prevent the early release of data. Yet, there was little within the pilot study surrounding openness during the research phase, something addressed within the main study (Chapter 7).

While the pilot study provided a useful glimpse into the broad issues surrounding organisation and openness and the development of the 2012-2016 Communications Strategy (2011), the majority of the pilot study was carried out while the Communications Group was in a 'heightened state', with communications activities at a high while communicating a significant new physics result. To complement this, an additional exploration of the CERN Communications Group during an otherwise 'steady state' was planned, to explore how these relationships are built, maintained and repaired during this time. This was carried out as part of the main study, outlined in Chapter 5.

As a result of the pilot study, a number of methodological changes were made going into the main study. Firstly, a change to the observational approach was needed. Within the pilot study, observations were relatively unstructured, often following a large number of people. This made the data hard to manage. Within the main study, observations focused on the activities of selected participants were used, which, when combined, would provide a greater understanding of the function of the Communications Group and their role in the dissemination of scientific information. As well as providing more manageable data, this approach also allowed for participants use of technology to be traced, something that was difficult to achieve within the pilot study.

Chapter 5 Main Study: Case Studies

This chapter documents narrative accounts of the ethnographic observations carried out with the eight participants involved in the main study, the six members of the CERN Communications Group and the two CERN researchers, following them through a working day (see Chapter 3, Section 3.3 for a discussion on ethnographic observations). These case studies provide an insight into Sub-Questions 5, 9-13 (Chapter 2, Section 2.6), through the tracing of the various communication activities of the Communications Group and the role they play in disseminating scientific information. The tracing of the participant's use of technology throughout the observations provides an insight into Sub-Questions 7-8, exploring how digital technologies have impacted on working and communication practices of CERN researchers and professionals. The time spent with the experimental and theoretical physicists provides additional insight into Sub-Questions 4 and 6 and the impact of the experimental work on communications and openness. While findings relevant to Sub-Questions 1-3 emerge through the case study analyses, these questions are explicitly explored through analysis of the interviews, described in Chapter 7.

The analyses presented in this chapter were developed by combining relevant quotes from interview data with the observational data. This combining of data streams adds depth and breadth to the analyses, with quotes providing the participant's interpretations of the activities witnessed, while placing the interviews in the context of the observations (see Chapter 3, Section 3.1.1 for a discussion on methodological and data triangulation and Section 3.5 for a discussion on 'thick description' narrative).

Each description follows a similar format, starting with an introduction and initial description of the participant's role at CERN and their working day. All names within the cases have been changed to provide some anonymity to the participants, as agreed in the consent forms (Appendix C). The narrative accounts then document the participant's working day before concluding with some insights coming from each study. The length of each case study varies depending on the range of activities undertaken by the participant on the particular day. The studies are presented in the order they were carried out. The chapter concludes with a summary of the key themes coming out of the case studies, which are explored further in the cross-case analyses in Chapter 6.

5.1 Social Media Manager

Kim's office is a short walk from the main hub of the Communications Group (c in Appendix A), along another corridor inhabited by a number of its other members, including the Editor of the *CERN Courier*[46] and the Graphic Design Team. Kim shares her office with Linda, an ATLAS physicist and resident blogger for CERN's official blog.

[46] *CERN Courier,* http://cerncourier.com/cws/latest/cern, last accessed 19.01.2016.

While the majority of her work focuses around social media, Kim has a number of other responsibilities across the Communications Group.

> "Social media is the main chunk of what I do, and then in addition I support the editor of the *CERN Courier* by writing certain things for the *CERN Courier*. I am also working on the annual report for CERN, so I am in the editorial team for that also again supporting the main editor in terms of the production and the deadlines and working with everyone. I'm also supporting the *CERN Courier* with things like the publications in the archives and getting those deliveries in and stuff. We did have someone that was helping her with that but her contract ended so the tasks have been spread around existing people, so hopefully that will get fixed."

While not part of her formal role, Kim has taken up these additional tasks after a member of the team's contract ended, with their responsibilities being spread around other members of the group.

5.1.1 Kim's Day

I meet up with Kim just after 9.00 in the office. After quick introductions, Kim and I rush over to the group's daily editorial meeting. These are short, 15 minute meetings held in a mezzanine connected to the group's audio-visual department. They are attended by various members of the Communications Group and those involved in communication activities across the experiments. While a longer meeting attended by all is held every

Monday, these 15-minute catch-ups are held Tuesday to Friday, allowing the group to discuss the progress of specific tasks or inform each other of anything new that has come up throughout the week. Due to the physical separation of the group (see Appendix A), these meetings are often the only time they are all able to get together. However, only a handful of people typically attend these smaller daily meetings.

On this day, Kim is joined by a member of the web team and one of the press officers to recap what was discussed at the previous day's editorial meeting in regards to a Press Release being sent out that afternoon.

> "On our Monday meeting at 10.00, we find out that something, that there's going to be this *Nature* article[47]. That a Press Release is on the horizon."

With the results coming through *Nature*, the Press Release[48] was under embargo until 17.00 that afternoon.

> "In this situation the Press Release was under embargo by *Nature*, because *Nature* had to get the information out first then CERN could communicate it. That's why there was an embargo on that particular Press Release."

[47] Nature Communications, *'A source of antihydrogen for in-flight hyperfine spectroscopy'*, http://www.nature.com/ncomms/2014/140121/ncomms4089/full/ncomms4089.html, last accessed 09.09.2015.

[48] CERN, *'Antimatter experiment produces first beam of antihydrogen'*, http://home.web.cern.ch/about/updates/2014/01/antimatter-experiment-produces-first-beam-antihydrogen, last accessed 09.09.2015.

Talking through this process with Kim, she explains to me where social media sits within the cycle of a Press Release.

> "So social media is very much at the end, and we've made that quite clear that we don't tweet before the Press Release has gone out. […] Typically it will be a Press Release is sent to staff then sent to journalists then tweeted. All in the space of like 10 minutes ideally."

When the meeting ends at 9.30, we head back to Kim's office. On arrival, Kim gets straight into a conversation with Linda about the Press Release about to be distributed. Linda is using the Press Release to write a post for CERN's official blog, but feels the Press Release is not clear enough and needs to be improved.

After their discussion, Kim returns to her desk and does a quick check of her emails. She then begins to set up a Google Hangouts™ page for an event they are holding that afternoon, sourcing pictures and information and adding links to relevant Youtube™ videos. The event is for High School biology students in the US and Kim wants to tailor the event to them, focusing on the impact CERN's research has had in biology. Kim wants to find CERN researchers who could talk about such impacts. Linda recommends a researcher she thought would be suitable for the event. With the researcher's name, Kim is able to search for the person in the CERN directory to get her contact number, but is unable to reach her by phone. As a result, Kim has to ask for a favour from Linda and get her to fill in for part of the talk.

With that agreed, Kim gets back to creating the hangout events page. Once created, Kim posts links to it through other social media channels, including creating an event on the CERN Facebook™ page and promoting it through Twitter™.

At 11.00 we head over to the CERN restaurant for Kim's second meeting of the day. This meeting is between Kim, the Internal Communications Manager and the organisers of an event being held as part of the CineGlobe festival[49]. Part of the event is a competition that challenges teams to tell a science inspired story in a unique, innovative way. With the competition open to any citizen or resident of Switzerland, the organisers are hoping to get CERN staff and researchers involved.

As a group they discuss the best way to promote the event through social media and internal communication channels, with Kim taking notes with pen and paper as they go along. Kim suggests coordinating activities through both CERN's social media channels and the *CERN Bulletin*. They decide to call for participants from CERN through the CERN Bulletin and the CERN website, as well as directly through email. Kim agrees to promote the event to the wider public through social media, including creating a Google+ event and using their Facebook™ competition 'guess what it is' to stir up interest, linking directly to the CineGlobe website.

[49] CineGlobe is an international festival of short films inspired by science that takes place every two years at CERN, http://cineglobe.ch/, last accessed 19.01.2016.

Using social media in this way, to direct users to relevant content, is one of the primary uses of these tools for Kim.

> "The main things I've come up with well in discussion with the web manager, that social media is the start of a journey. So you know I like to think we a reaching into social media where people are anyway, they are using it to chat with friends or find out news and we are just giving them the opportunity to come to the website, to look around and then maybe go to different parts of the website. So in a way we are hooking them from social media and pulling them to the CERN content, so that's one of the things that I am very mindful of in social media strategy."

The meeting ends at 12.20 and we break for lunch. We meet back up in the office at 13.30 where Kim spends the next 50 minutes replying to a few emails and creating slides for a presentation being given as part of the Google Hangout event. At 14.20 Kim receives a phone call letting her know there are documents ready to be picked up from the archive room. We headed down to collect the documents, with Kim arranging further deliveries to be made.[50]

[50] This two minute conversation with the archive manager was carried out in French. Kim was asked to clarify what had been discussed following the conversation.

We return to the office at 14.30 where Kim continues to make slides for the hangout. At 14.55 Kim receives an email regarding a visit to ATLAS she was helping to arrange. Instead of replying by email, Kim decides to phone as she feels it is easier for her to sort out the specifics of the visit over the phone rather than through numerous email exchanges. Kim will often prefer the phone over email in such situations.

> "If I'm not 100% sure how to formulate a response or question I'm asking, then it's sometimes quicker to phone them then it is to try and craft an email that's is going to make coherent sense."

When finished with the phone call, Kim goes back to working on the hangout event, sporadically checking emails in-between. Once finished with the slides, Kim runs them past Linda who offers a few suggestions. The two also discuss the running order of the event and what they want to get across. One aim of the hangout is to promote CERN's Beam Lines for School Competition[51], as well as the upcoming Google Science Fair.

With decisions made, Kim makes a few alterations then emails the slides along with plans for the event to the various speakers. Once sent, Kim follows up with the people from the Cineglobe meeting, emailing them with her plans for social media.

[51] A competition for school students, giving them a chance to use one of CERN's beam lines to carry out their own experiment, http://home.web.cern.ch/students-educators/spotlight/2013/competition-beam-line-schools, last accessed 20.01.2016.

With the hangouts going live at 16.30, we head over to the media room at 15.50 to set everything up. Kim connects up her laptop and signs into the hangout. After a slight delay, two of the speakers join us in the media room, while another scientist connects live from the CMS Cavern. Finally, Kim connects directly with the High School class the hangout is being primarily done for.

With everyone in place, Kim sends out final reminders via Twitter™ and Facebook™ to promote the hangout before going live at 16.30.

During the hangouts, Kim’s main role is to switch between slides and speakers. The speakers provided some background to CERN, as well as an overview of the detectors and the LHC. Parts of the talk also focused on the upgrades being carried out on the LHC, as well as some of the impacts on biology and medical science.

The hangout didn’t run completely smoothly, however. There were issues with the sound throughout, with the presenters not being able to hear the questions they were being asked by the students. Some of the presenters also used quite technical language, something Kim is particularly mindful of. As she did with this hangout, Kim will attempt to tailor the event for the specific audience.

"That was a special one yesterday[52] because it was very much for that school that we were, they were our main audience. The fact that we were broadcasting it was kind of a bonus really, but typically our main audience is the one we are broadcasting to. So it's interesting so I am always trying to pitch it for general public, then the scientists that take part I think they use lots of jargon, so I think it has to be quite a physics minded or scientifically minded general public that is going to get a lot out of it. So we are always having this struggle between making it really accessible and, but we have found that the more techie ones are more popular so maybe we don't need to make it as accessible as I would have initially thought. I don't know, we are still playing around with things, but the techy ones went better than I thought they would, so people do like chunky, meaty science. […] I mean the outcome is quite scrappy, but it shows the human side of CERN at least, but we are looking into improving the technical side of things so we will see how it goes."

While Google Hangouts™ is aimed at this technically minded general public, Twitter™ and Facebook™ are aimed at slightly different audience.

"So general public is the overarching audience, but then on Twitter™ we have a lot of journalists looking, so I am very mindful when I write a tweet that it's for

[52] Note: Interviews were carried out the day after the observations.

> general public and for journalists, whereas Facebook™ it is for general public and for students. It's a younger audience."

With the hangouts concluding at 17.05, we head back to the office just as the Press Release has been sent out by the Press Team. With links to the blog post, Kim sends out a Tweet, followed by a Facebook™ post. Typically, however, Kim will post links either directly to the Press Release on the Press Office site or to a web update on the main website.

> "They also put it [a Press Release] on the press office website, and then typically Liam from the web team will then take the content and edit it to make it into a web update for the web site. He will have an image as well and put that in. Then he will tell me when that link is ready, and depending on the time it takes to go from the Press Release being released and Liam putting that web update up, I will either tweet to the Press Release if it's something that really needs to go out fast, or I will wait for Liam and tweet to his web update. I will Facebook™ and Google+ to his web update; including the image the he's used because they are much more image based social media channels."

In this way, Kim is using social media as described earlier, to draw people to CERN content, hoping they will explore further. Kim also uses social media to create "positive sentiments" towards CERN.

> “We are looking at positive sentiments, so trying to maintain a positive sentiment towards CERN, and just making sure CERN is seen well, so addressing negative comments and making sure there a lot of ambassadors out there who are passing the word of CERN.”

In this respect, social media appears to have an underlying public relations function, rather than just a communication or a public engagement tool. Here, the positive sentiment desired indicates the use of social media by the Communications Group is not aiming to achieve balanced reporting of information, instead as a tool to promote CERN.

5.1.2 Summary

With the day concluded, I went away to process what I had observed, with a couple of issues jumping out early on. The first thing was apparent was the physical organisation of the group and the distance between Kim and the other members. As Porter-O'grady (1997) argues, the effectiveness of an organisation depends on the level of partnership, integration and inclusion, which is achieved through various measures such as effective dialogue. The physical separation between the group makes it difficult for them to communicate effectively. While there are daily editorial meetings between various members, allowing some form of daily dialogue, this observation indicated these meetings are used to coordinate specific tasks rather than share information. Munkejord (2007) describe such meetings as ‘puzzle zone practices’ where smaller groups come together and are often focused around solving specific problems and updating each other on current tasks. This separation and lack of effective dialogue within the group may cause issues at a number of Keyton's (2005) levels of organisational culture. The distance could create a breakdown at Keyton's (2005) process element, with a lack of interaction and information sharing between the group in turn impacting on Keyton's (2005) subjective element, the inter-relationships between the members of the group.

The observation day was particularly useful in establishing where social media fits in the communication cycle and the role Kim plays as Social Media Manager. Using Fahy and Nisbet's (2011) typology (outlined in Chapter 2, Section 2.4.5) of science journalists as a starting point, Kim appears to fulfil a number of these roles, primarily as 'The Conduit', breaking down scientific information into easily accessible forms and disseminating them through social media, Furthermore, the Google Hangouts™ Kim arranged brought scientists and the public together and allowed direct interaction, fulfilling the 'Convenor' role. Yet, it appears social media also has a distinct public relation function in the CERN Communications Group, with her 'Advocate' role aiming to create and maintain "positive sentiments" towards CERN across their audiences. As Borchelt and Neilson (2014) describe, public relations is coming to play an increasingly prominent role in science communication. From this evidence, it appears that social media plays a crucial role within the public relations function of the Communications Group. I therefore wanted to explore if such public relations functions play a part in the roles of other members of the CERN Communications Group.

The observation also provided specific examples of how digital technologies have allowed novel forms of digital scholarship, with the use of social media to engage with particular audiences indicating a shift towards 'Networked Participatory Scholarship'[53] (Veletsianos and Kimmons, 2011). The use of Google Hangouts™ in particular facilitated a direct connection between two geographically separate groups, CERN researchers and American High School students, facilitating short term engagement between the two without the need to travel. This also provides the first glimpse into the role the Communications Group plays in the process of scientific mediation and their position in the 'Circuit of Mass Communication' (Miller *et al*., 1998). The use of social media, particularly Google Hangouts™, facilitated direct engagement between two of the actors in the circuit, the scientific institute and members of the public (in this instance High School Students). Kim also explained that she's aware of the value of Twitter™ in reaching newsrooms, as well as the general public, often making her tweets' headline friendly to attract journalists.

While digital technologies have allowed these novel forms interactions between various audiences, pre-digital practices still survive and even effect how digital technologies are used. This is best illustrated through the handling of the embargoed Press Release.

[53] Network Participatory Scholarship is discussed in Chapter 2, Section 2.4.1.

While embargoed Press Releases are important information subsidies (Gandy, 1982), continuing to play an important role in framing media content, there are a number of questions raised in terms of its place within the digital age (Holliman, 2000; 2004). With traditional embargos, findings or results published in peer-reviewed journals, in this case *Nature,* are circulated amongst journalists under embargo ahead of publication. The purpose is to allow journalists enough time to prepare articles, while also allowing journals to control the release of data to attain maximum publicity (Kiernan, 2003). Yet there a numerous critiques of the embargo process and its impact on the integrity of scientific reporting (Allan, 2011). Kiernan (2006) argues the use of embargos encourages news processing over reporting and has serious implications for openness, with a select subset of journalists able to set news agenda. Davies (2008), describes this passive processing of embargos, often coming from public relations departments, as 'churnalism'. Yet, as Allan (2011) points out, there is still potential to sustain/improve science journalism through the developing forms of connectivity brought about by the digital age.

It could be argued that the 24 hour rolling news that digital technologies, such as social media, afford runs counter to this established journalistic practice of embargoes. As Kim explains, the Communications Group places social media at the end of the communication cycle, after the traditional information subsidies have been disseminated. Based on this observation, it appears then social media is used by the Communications Group to complement these traditional practices, linking to Press

Releases and articles, rather than fully utilising the novel engagement features they support. With this in mind, I wanted to find out more about how the Press Release was constructed and the relationship the Communications Group has with external journalists. This was explored during interviews and observations with the Head of Press and the Head of Communications.

5.2 UK Communications and Innovations Officer

It’s clear when walking along the corridors at CERN that the majority of their money is not spent on the fabric of their offices. In no place is that more apparent than the 'office' of Susan, the UK Communications and Innovations Officer based at CERN.

Susan is hidden away in a windowless space adjacent to the main dwellings of the CERN Press Office (d in Appendix A). With no natural light, the buzz of activity that filters through the poorly insulated walls is the only indication of life outside the office.

> “It’s actually quite shocking how bad the fabric of the building has become! But then I don't work for CERN, I'm just lucky I have a desk in a cupboard!”

As she describes, Susan is not employed directly by CERN, but is contracted with STFC[54] and based at CERN within the Communications Group. Contractually, 80% of Susan’s time is intended for STFC where she fulfils a mix of communications roles, including finding stories that relate to UK nationals or UK Universities based at CERN, or

[54] The Science and Technology Facilities Council, http://www.stfc.ac.uk/Home.aspx, last accessed 20.01.2016.

companies that supply technical equipment to CERN. When she is out finding stories, Susan will also try and find innovations or inventions that have been developed by UK scientists and help promote them further. The other 20% of her contracted time is to work in the CERN Press Office.

5.2.1 Susan's day

Arriving at her office at 8.45, Susan is already busy working through her emails. With two email accounts, one for CERN and one for STFC, managing emails is an important part of Susan's day. As she is separated from her colleagues at STFC, keeping in contact with the rest of the group is extremely important for Susan, with technology playing a crucial role in how information is exchanged and how these relationships are maintained at a distance.

> "For me it's important that people still think of me as a member of the team [STFC], that just because I'm out of sight I don't want to be out of mind."
>
> "Most of my team that I work with is in the UK, and there has to be an exchange of information between the UK and here (CERN), and quite often particularly if you are sending one to many information then it's done by emails."

It doesn't take long however, for technology to fail Susan. When trying to connect to her STFC email through webmail, the page remains unresponsive. According to Susan this is a regular problem she faces.

> “We [STFC] have a very flaky email server, and when you are using it remotely with web-mail, it sometimes falls over.”

As a result, Susan will often fall back on commercially available technologies, such as Facebook™ Messenger, Skype™ and the phone to contact colleagues directly.

> “I do try and push my UK colleagues to use Skype more than the phone […] So for me it’s about seeing people, and it’s about being able to maintain, say the physical contact, but it’s about still having the 80% of communication that is non-verbal and to me that is quite important. I would much prefer people to Skype me rather than phone me, but then I would much rather they phone me than email. So it’s sort of, email seems to me much easier to misinterpret tone of voice, it’s a very good way of exchanging factual information, but if you want opinion or conversation or the slightly more social side of information exchange, to me it’s not as effective.”

While technology such as Skype helps reduce the impact of physical separation from her UK based colleagues, and emails allowing the easy transferring of information, face-to-face is still Susan’s preferred means of communication, especially for internal communications.

> “I would much rather walk down to the restaurant and sit face-to-face with somebody and have a coffee with them [then use Skype, emails or the phone].”

After giving up on her STFC emails, Susan heads over to the CERN Communications Groups daily editorial meeting. Susan will often use these meetings to gather new stories or to share information with the other members.

> “If I'm short on stories then I nearly always [attend the meeting] because sometimes you will pick up on something. Also, if something has cropped up overnight or over the previous 24 hours that I think might be of interest to the wider editorial group then I will take it to that meeting.”

This particular Wednesday meeting was attended by CERN’s Social Media Officer and the CERN Communications Officer for the US[55]. Normally within these meetings, Susan has one primary goal, to find any stories that might involve UK researchers or institutions. As such, Susan’s first question whenever a member of the Communications Group is talking about a new story they are working on is, “Is there a British angle?”

> “It's become a bit of standing joke within the Comms Team, that I’m only interested in a story if there's a British angle.”

> “For me I absolutely do want the UK angle. It has to be either a UK national or a university or a UK school or a UK company, and I'm absolutely clear on that.”

[55] This person has a similar role to Susan, representing the US department of energy at CERN.

On this day, Susan's main intention was to find out more information about an upcoming Famelab[56], a competition supported by The British Council[57] that seeks out new science communicators. Once again Susan was trying to find out about any participation by UK scientists in the competition. The Social Media Officer, Kim, promised to forward an email with the information of those taking part.

The meeting finishes at 9.35am, after which we rush back to Susan's office to collect her keys and security pass before heading to CERN's Prevessin site to carry out interviews with three UK researchers working on beam instrumentation for CLIC[58]. Susan takes one of the CERN cars reserved for the Communications Group and drives to the site. On arrival at 9.55, we head to the on-site restaurant where Susan has arranged to meet the researchers. She buys them all a coffee and introduces herself, explaining what she wants from the interviews and how they will be used in her article. Susan encourages each of the researchers to break down their projects into simple terms that could be understood by a non-physics audience. The three researchers were all from UK universities, two of them were PhD students, while the third was a Project Associate.

[56] Famelab, http://www.famelab.org/, last accessed 20.01.2016.

[57] The British Council, http://www.britishcouncil.org/, last accessed 20.01.2016.

[58] The Compact Linear Collider, http://clic-study.web.cern.ch/, last accessed 20.01.2016.

Instead of recording the interviews, Susan takes longhand notes with pen and paper. When I interviewed her and asked her the reasons for this, Susan argued that this is the easiest method for her, preferring it to digital recording devices.

> “I find that if I'm using pen and paper it means I can easily go back to something that somebody has said and I can append another note to what they have just written, which I'm sure you can do if you are really quick with the technology […] but for me I would have to start by learning that technology and going back. I've thought about using digital voice recorders but for the same reason, I, in some way I think it’s quicker for me to transcribe an article straight from my pen and paper notes then it would be to transcribe a discussion over 30 minutes and then work out what I want to use from it.”

As the interviews begin, the first researcher is able to break down her project into simple terms, giving clear examples and analogies. Clearly nervous, the second student struggles to do the same. Susan has to reassure him and encourages him along the way, calling on the others to help explain the project.

An hour later the interviews end. Susan debriefs the researchers and promises to send a draft of the article before it’s published to make sure it’s a true representation of what they said.

After returning to her office, Susan spends the rest of the day at her desk putting together the article. In doing so, she reviews the notes she had made and previous stories about CLIC, using quotes and stock phrases to construct her article. This article forms part of Susan's main communications activity, a fortnightly newsletter called 'UK News from CERN'[59]. As Susan describes, this newsletter is aimed at key decision makers within the UK.

> "The absolute primary audience is this Science Minister and other key advisors within government and key stakeholders in the UK [...] The aim is to raise awareness on the return of investment that the UK gets for its 100 million pounds at CERN."

As well as the Science Minister, the secondary audiences include the science community, in particular physics communities at CERN and in the UK, who are able to subscribe directly to the newsletter, as well as access it online.

The fortnightly deadline of the newsletter provides routine to Susan's working practices.

> "There's a sort of cyclical element to my fortnight anyway in terms of interviewing people, writing articles, finalising and so on, so that tends to set the rhythm of my work, and I would say that is probably my priority because it's interviewing people for the newsletter, that tends to give me the innovations side of the role and so the two sort of feed off each other."

[59] UK News from CERN, http://www.stfc.ac.uk/2596.aspx, last accessed 19.01.2016.

While a number of her working practices observed were similar to that of a journalist[60] Susan was keen not to identify herself in this role.

> "It was almost quite a...... fundamental day in a sense, of going interviewing three students, coming back writing up the article, sending it to them, and that was pretty much the day, with a couple of other bits and bobs thrown in."

> "I don't consider myself a journalist and I never have done, I am most definitely a public relations professional."

> "My intention is to represent the UK and the people that I talk to in a positive light. I am not at any point trying to make us look anything less than perfect."

Susan's intention with her newsletter is to represent the UK and the researchers she interviews in a positive light, rather than providing balanced reporting on CERN.

5.2.2 Summary

Once my observation day with Susan had finished, I made some early notes about what I had witnessed during the observations. There were a number of key themes that came up during the observations that I wanted to further explore during the interviews. The first thing that struck me during the observations was the physical organisation of the group, the space Susan worked in and the separation between the various members of

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[60] For a discussion on the working practices of journalists, see Fahy and Nisbet (2011) in Chapter 2 Section 2.4.5.

the group. It appeared from the observation that the only time the group got together as a whole was for the weekly editorial meeting and in smaller numbers in the daily meetings. A lack of interaction and information sharing between the group may indicate a break down at Keyton's (2005) second level of organisational culture, the process element, which may impact on the third subjective element (discussion of Keyton's (2005) organisational culture is presented in Chapter 2, Section 2.2). Lacking effective channels through which the members can engage and interact with each other may mean information, such as upcoming stories, is not shared effectively or may be missed completely. This can put more pressure on catch-up meeting which may reduce their effectivity. In turn, this could affect how much information is disseminated into the public sphere. I therefore wanted to find out more about how such separations were effecting communication and working practices of other members of the CERN Communications Group, and if it was impacting on other aspects of internal and external communications and openness.

The second theme that emerged was around Susan's use of technology in her working and communication practices. Susan has embraced a number of digital technologies that allow her to stay in contact with colleagues back in the UK. Remaining thought of as one of the team is very important for Susan, with digital technologies providing a channel through which relationships can be maintained. As discussed in Chapter 2, Section 2.4.4 the adoption and use of technology by media professionals is influenced by a number of factors, such as the individuals daily routine (Domingo, 2008), workplace organisation

(Majoribanks, 2000), available resources (Ursell, 2001), technical skills/multimedia competences (Deuze, 1999) and the professionals individual needs/desires (Domingo and Castello, 2006). 0Within this case study, Susan's desire to stay in touch and maintain relationships with colleagues in the UK lead her to adopt Skype as her primary communication tool, with its audio/visual function providing virtual 'physical contact'. Email on the other hand, while allowing information to be shared across the distance and to a potentially large number of people, doesn't allow for the more social side of information exchange (Rice, 1993; DeSanctis and Monge, 1998).

While embracing certain digital technologies that allow her to stay in touch with colleagues back in the UK, Susan still uses pre-digital newsgathering techniques, with pen and paper interviews and longhand notes being preferred to digital audio recordings. Here, Susan's decision not to use digital technologies in place of analogue ones come down to her technical skill/multimedia competence (Deuze, 1999) and her personal preference for the pen and paper. As she describes, pen and paper interviewing and note taking is more efficient for Susan, with digital audio recorders or digital notepads not providing the same speed or working flexibility. In terms of technical competence, Susan would be required to learn how to use a new tool and a new way of working. This process of reskilling can be time consuming.

These examples of technology use within the observations demonstrate the very mixed relationship Susan has with technology and its use within her working and communication practices. Comparing Susan's use of technology with Grand *et al's*. (in press) typology of digitally engaged researcher, that broadly categorises users based on their use of technology in their communication, working and engagement practices, Susan's behaviour places her within the two extremes, almost simultaneously 'highly-wired', using digital tools and technologies to remain in contact with distant colleagues on a daily basis, yet 'unconvinced' when it comes to her continued use of pen and paper within her working practices[61].

The final theme coming out of this case study was how Susan viewed her professional role within the Communications Group. Throughout the observations, Susan employed many traditional journalistic practices in terms of her news gathering and writing practices. Employing Fahy and Nisbet's (2011) typology of journalists, Susan fits into a number of these categories. The interviews with the three students sees Susan act as 'The Conduit' breaking down their research for a non-specialist audience. Putting together her regular newsletter, Susan's also fulfils a 'Curator' role. Yet Susan made it clear that she sees herself as a public relations professional, not as a journalist, and is not attempting to be balanced, in a traditional journalistic sense. Here, Susan identifies with Fahy and Nisbet's (2011) 'Advocate' role, with her reporting of CERN aiming to make them look as good as possible.

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[61] See Chapter 2, Section 2.4.

As Borchelt and Neilson (2014) describe, public relations activities can be used to develop relationships with publics and interested parties, in order to gain and maintain support for the work of the organisation. The main activity Susan undertakes is the production of a fortnightly newsletter, UK News from CERN. As she describes, the primary audiences are the UK Science Minister and key advisors within government, with the newsletter aiming to raise awareness of the return the UK gets for its financial investment in CERN. These government officials in CERN Member States are key stakeholders, and one of the groups specifically mandated for within CERN's 2012-2016 Communications Strategy (CERN, 2011), with Susan's newsletter providing direct communication to this group. Such public relations functions need to be taken into account when addressing the role the Communications Group plays in the dissemination of scientific information.

5.3 Internal Communications Manager

Another team within the Communications Group, squeezed in along the 'Communications Corridor' is Internal Communications (g in Appendix A). This three strong team is led by Internal Communications Manager, Francesca.

Francesca is in charge of the majority of internal communications at CERN, including the fortnightly newsletter *The Bulletin*, as well as the information screens you see dotted around CERN. Francesca's team is also responsible for circulating Press Releases and special announcements to CERN personnel via email[62]. Francesca is also one of the few people who can send emails to all CERN personnel. Francesca argues, however, that with great power comes great responsibility.

> "We try not to do it too often because people don't like to receive too many emails. They feel sort of spammed when you send them too many things, so we try to really use *The Bulletin* as the main channel for people to keep up with what's up at CERN."

The Bulletin is therefore the top priority for the group, and this fortnightly publication gives a two-week cycle to their working routine. The first week is spent carrying out interviews, gathering stories and writing articles, similar to traditional journalistic practices. The second week is then spent preparing the issue, arranging the layout, editing and finally publishing. These second week tasks are often handled by the other members of her team, leaving Francesca free to work on additional tasks.

> "They [Francesca's team members] are 100% on *The Bulletin* and all the internal communications matters, which means that for me in the second week, while they do all the layout and proof reading and, you know, final editing and all this, I'm actually quite free to do, for example, the interviews that I need to do for the

[62] Not all Press Releases are circulated by the Internal Communications team. Significant Press Releases are sent to personal directly by the Director General.

> next bulletin, but it allows me to have more time. It doesn't mean the first week I don't deal with all the rest, it cannot be like this, but it's true that in their first week I really have *The Bulletin* as priority one and I tell myself this is, 'you don't go home until you have done this and this for *The Bulletin*', or at least if I go home I continue this because I know this is the priority."

While *The Bulletin* is Francesca's top priority, she is also involved in numerous other projects, such as organising the Swiss version of Famelab, Masterclasses[63] and training days for Italian teachers.

5.3.1 Francesca's day

I meet Francesca as she arrives at her office at 9.20. She explains to me how before getting to work she will have already checked her emails and dealt with anything urgent at home. This allows her to jump quickly into work on arrival. Francesca often chooses to work outside of office hours, allowing her to distribute her time and workload to best suit her. This distribution is, in part, facilitated by digital technologies.

> "I judge for myself whether something becomes a priority for me and then whether I stay in the office or after I've put the kids, once the kids are asleep. So this is up to me. I really enjoy this flexibility, for me it's very important because it

[63] International Masterclasses, Hands on Particle Physics, http://www.physicsmasterclasses.org/, last accessed 19.01.2016.

really allows me to distribute the workload in the way I want, and not in the way the system thinks it should be done, you see. I feel very, very happy because technologies help me a lot, so I enjoy being always connected because in that way I can say don't call me, send me an email, and I can decide on the priority, you see. It's a kind of a domino effect. If you are always connected, then you are the master. In this way I really can distribute the workload."

Despite her preferences, Francesca is aware that others do not share her attitudes towards working outside of office hours. As such, Francesca is careful not to email out of these times.

> "I prepare emails [out of office hours], but I only send them, I try and send them only on weekdays, so that people are not annoyed. But I prepare the emails, so Monday I can just push send."

After a quick conversation with a colleague in her team, Francesca looked over a number of articles that are being prepared for *The Bulletin* before heading over to a series of physics presentations being held in Building 1 at 9.55.

With the presentation having already begun, we quietly slip into the room, standing in the shadows at the back. Francesca is only interested in one specific presentation from a

CERN physicist who had recently visited the Fukushima power plant[64]. Francesca had been told about the talk and wanted to see if it would make for a good article for *The Bulletin*. This is one of the main ways Francesca sources stories.

> "Because we deal with internal communication it's actually people from the internal community who trigger the articles, so I receive emails saying would you like to do this, I have this story coming up, would you like to cover it."

Being informed by the CERN community about upcoming stories, Francesca is then able to inform the rest of the Group what they are planning on doing at the weekly editorial meeting.

> "When I come to the Monday meeting it's actually known already, if you see what I mean, with some exceptions from time to time. It's more that I tell people what we are going to do, and it's not necessarily of interest to everybody, but at least these are stories that people have come up with from the internal community. That I think is specific to the internal community, internal communications. It's really, *The Bulletin* has been there since the beginning of CERN, people still call it weekly because it used to be weekly. They send me message to weekly.bulletin@cern.ch which it isn't anymore, but it's in their heads and people know that this thing is there. […] The natural channel for them

[64] Japanese nuclear power plant, damaged in March 2011.

is *The Bulletin*. It's a very active community […] I don't think that other communities are as active as this in this respect, reactive as this one. Usually you publish a newsletter and nobody cares."

Despite having these weekly editorial meetings, Francesca feels there are not enough opportunities to share information across the group, with the smaller daily meetings not allowing for effective exchange of information.

> "I mean there is no time to really exchange with colleagues. We only have this 30 min editorial meeting, and then of course people also meet at nine [9.15am] every day, but I don't think these are very useful [meetings]. Not many go and also there isn't much coming up, and it's not these kind of meetings I believe we need. It's more at the level of knowing what the other people are doing. It's more at the level of the group that things should happen, not just to look for the news of the day, that's not needed."

> "There is no, how do you say, transverse [communication][65]. You have different sections, but yes that's what we probably need. But anyway that's something that also has to do with resources, because we could have more people, these people could be in many different things instead of one single thing because we need people to concentrate on something otherwise we don't manage to deal

[65] Communications across the sections of the Communications Group.

> with that. So, for example, if the girls from my office could be involved in social media or something else, the website or brochures. There's no time for them to do that, that's why they do only their thing."

With the presentation over, we sneak out at 10.15 and head back to the office. The next few hours were spent managing emails and finalising articles for *The Bulletin*. On numerous occasions during the day, Francesca collaborated with her team on articles, using track changes on documents and emailing them between each other. The group also makes use of their Document Server so they can track who is working on what article.

After Lunch at 12.55, Francesca returns to the office and begins work on another project she leads, CERNLand[66], an online platform that attempts to engage children, 7-12 year olds, with CERN's research through games, films and news. During this time I was asked to look over an article they were about to put up on the CERNLand Newsroom[67]. The newsroom for kids was being maintained by an intern from the University of Milan who was working with the Internal Communications Team.

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[66] CERNLand, http://www.cernland.net/index.php?, last accessed 21.01.2016.

[67] At this point I switch from observer-as-participant to a participant observer (see Chapter 3, Section 3.3.4 for a discussion of such a switch). During this time Francesca was managing emails and reviewing other articles.

When asked to look at the article, I was immediately struck by the title 'Your Cigarette Butts in the Sea?'[68]. The evocatively named article for children and young people aimed to inform them about environmental pollution, particularly water pollution. It appeared the majority of articles on CERNLand were reworked versions of *The Bulletin* articles. When asked about the future of CERNLand, Francesca didn't have much hope for its continuation due to financial constraints.

> "I don't have enough funds to [Continue with CERNLand], unless David [the Head of Communications] changes his mind, I don't think I will have funds to continue unfortunately. That's life in a way, I mean we are aware that not all of the projects we deal with can be priority one for the whole group. It's tough here, you don't have enough personally to do all the things we are dealing with, so I personally do understand that CERNLand newsroom cannot be priority compared to neighbour communication or this kind of things that are really in the balance. You can't really say 'Oh no you should give me money for this'. I would love it, and I think it would be a good investment, but putting this in the whole context of the group I can also see that it's difficult."

[68] CERNLand, Your Cigarette Butts in the Sea, http://www.cernland.net/news-room/en/post/43/your-cigarette-butts-in-the-sea.html, last accessed 21.01.2016.

While the rest of Francesca ’s day was spent in the office, she did have a couple of visits from a colleague from CERN’s Education and Outreach Team, calling on Francesca’s physics background to help in the wording of talk she was giving the next day. For Francesca, her background in physics and education is key to her communications role.

> “I’m a physicist by education […] It makes a difference because when you have to deal with physicists or engineers, they see someone coming from communications who doesn’t really understand, in addition a woman, she will never understand things. I can tell you that may times it happened to me with CERN people, the surprise that I understand everything they say. […] I think that it is useful to have a scientific background, whatever it is, doesn’t need to be physics, but you need to have a scientific background. Or not, but if you have no scientific background the articles you can deal with are much less. I mean you have much less possibility to really interact with these works.”

During the afternoon, Francesca also received six phone calls, on both her mobile and landline. Where possible, Francesca would leave the room when on the phone to not disturb her colleagues.

> “[Talking about the use of the phone] Yesterday was kind of an exception because it was really a lot in the afternoon, but this is completely unusual.”

> “This is the main reason [noise levels for not using the phone], this is absolutely the main reason, to try to limit the disturbance, volume of the voice, because

this is important I think because being both week one and week two is no difference we need to be concentrated on what we are doing. So we usually have earphones in in week one. It's essential we listen to the interviews. We record the interviews as you do, so we have to listen to the recordings, but in week two it becomes normal for us to try and isolate ourselves and really be concentrated on what we do. So yes, now the limited [use] of the telephone for me is also important because when you receive an email, you can assign the priority you want to the inquiry."

> "If you receive a phone call, then it gets immediately priority over anything else, where as you don't want this because you, for example, if you are working on an article and you get interrupted ten times then, I mean each time you have to get back and concentrate and what was I doing, you see. So I really try to limit the use of the telephone as much as I can, but I constantly monitor my email, and people know, people who are interacting with me, they know very well that it's much better to send me an email then call me, because I'm not always in the office, and I don't have a work mobile."

As well as emails, Francesca also uses other digital technologies to communicate with people outside of CERN. Francesca was in fact planning a Skype™ meeting that afternoon, but it was cancelled. When asked about the use of such tools for meetings, Francesca saw multiple benefits of free to use social tools over other technologies.

> "I use Skype™ a lot, or Google hangouts. I'm organising Famelab and this is with people in Zurich and Bern and so, so we do most of the work by email or with meetings in Bern, but there are days when we do Skype™ calls. I do a regular Skype™ call for CERNLand, because one person, the webmaster, he's from Switzerland so he's either here in Geneva or Bern, and yet the graphic artist is in Milan, so we do a Skype™ call regularly. We often have to follow the progress much more frequently, much more then we can really meet."

> "Google Hangouts™ depends on what people really prefer. Now the two technologies are almost, pretty much the same level. The good thing with Google+ is of course you can see the people; they are real virtual meetings. There are many applications that I know for meetings, but I don't need all these features and things, minutes to keep and all these, so I keep it simple."

> "The difference between Skype™ and Google+ is you cannot do really, video meetings with Skype™, you have to have a subscription for that, but Google+ allows you to do that for free."

While CERN provides software (Vidyo[69]) for video conferencing, it is optimised for use by physicists holding distributed meetings.

[69] Vidyo, http://www.vidyo.com/, last accessed 21.01.2016.

> “CERN have their own, they use Vidyo, but people outside use Skype™, uses Google+™. When I go to Zurich or to Rome, they use Skype™, so I use Skype™ and that’s so easy, for me it doesn’t make sense to complicate my life.”

Free to access software such as Skype and Google+ are also quicker and easier to setup and use. Francesca is able to use these at her desk if needed, whereas she would have to book a room elsewhere if she was to use CERN’s video conferencing tools.

5.3.2 Summary

Following on from the observation day with Francesca, there were a number of issues that I wanted to explore further in the interview. The importance of *The Bulletin* as a printed publication was quite apparent during the observations. Francesca argued that *The Bulletin* was held in high regard by the CERN Community, with its corresponding email address an important channel through which her team gather stories. As she describes, Francesca will often inform the other members of Communications Group as to what her team are working on. Informing the rest of the group as to what Internal Communications are doing instead of informing them of everything that has come up may create issues at Keyton’s (2005) *Process* level of communication behaviour within the organisation. Stories may be sent to Francesca that may not be deemed suitable for *The Bulletin,* or that they don’t have space to run, therefore they may not be shared with others in the group. In this respect, Francesca is the first to decide what is deemed newsworthy (this gatekeeping role is discussed below). If the channels aren’t then in place to share stories with the rest of the Group, this could impact on the overall dissemination of information from the group.

Another issue that may be impacting on Keyton's (2005) second level of organisation culture is the effectiveness of the group's daily and weekly editorial meetings. With the group distributed across the CERN site, these meetings are one of the only time the various members of the group are all able to get together. However, Francesca describes how the group do not meet often enough, and the meetings they have are not achieving what she believes is needed. Francesca argues the group needs to improve this horizontal communication between the sections to improve the overall effectiveness of information sharing.

Francesca's attitude to working outside of office hours, and the flexibility digital technologies has provided her, was also of particular interest. Francesca has seemingly utilised digital technologies to distribute her work outside of set hours. This attitude is similar to those of Tapscott's (2009) 'Net Generation' of workers (see also Holliman, 2007). Tapscott (2009) outlines how 'Net Generation' workers prefer to work flexibly in time and space, and have a particular emphasis on interpersonal relationships in the workplace, which they can maintain virtually. As Francesca explains, she utilises digital technologies to create this flexibility in working hours. Difficulty comes, however, when colleagues don't share such attitudes towards working practices and out of office hours. Francesca is clearly aware that some of her colleagues do not appreciate being contacted outside of office hours and modifies her behaviour accordingly. Grand *et al.* (in press) describe this as a ‘muddled community’, where mixtures of types of digitally engaged individuals exist within a community. Francesca seems to fit well within the ‘highly-wired’ type, utilising digital technologies throughout her working and communication (see below) practices. I therefore wanted to compare attitudes towards working hours with other members, and if others had utilised digital technologies in such a way.

Francesca’s use of communication technologies also stood out during the observation day. While Francesca received numerous phone calls during the observations, she makes it clear this is not her preferred method of communication. For Francesca, email provides a great deal of control of contact, as she is able to assign priority to each message and deal with issues at her pace. In this respect, Francesca benefits from the asynchronous nature of email communication (Peters, 2006). The phone on the other hand doesn’t give Francesca the same level of control as emails. As she describes, a phone call immediately takes priority and can cause a lot of disturbance for Francesca and her team. This was in contrast to the previous participant, the UK Communications and Innovations Officer, who preferred communications technologies that allowed for the more social aspects of information exchange, such as the phone and Skype™. Francesca has also utilised other digital technologies, such as Skype™ and Google+ to connect with geographically disperse colleagues, once again appearing as a ‘highly-wired’ individual (Grand *et al.*, in press).

Within this case, Francesca touched on an important issue within STEM, that of gender representation and bias. As Blickenstaff (2005) explains, women are under-represented in scientific careers across most industrialised countries. Of the STEM disciplines, physics has continuously been shown to have one of the lowest representations of women (Ivie and Tesfaye, 2012; Settles *et al.*, 2006; Zohar and Sela, 2003), often viewed as a masculine science by nature (Blickenstaff, 2005). Within this case, Francesca hints towards a stereotype she feels exists within physics, whereby a woman would not understand the complex scientific research carried out. Such stereotypes have been reported elsewhere within physics. Hazari and Potvin (2005) describes how stereotypes that undermine the capabilities and interest of women in physics have been ever-present across physics, and more broadly in society. Whitelegg *et al*. (2002), also discussed this within physics, reporting that older males (over 55) were perceived as holding such stereotypes, especially towards younger women within the discipline. As Francesca goes on to describe, this issue is exacerbated by researcher's views on communicators. Again, Francesca indicates that researchers seem to think communication professionals (of any gender) would not understand the science. Once again, this issue has been well documented over the years. Hartz and Chappell (1997) described scientists and communicators (in their case journalists) as strangers, unable to understand each other's language and driven by different agendas. While more recent studies argue this 'gap' is not as big as it once was (Peters, 2013), it is still present in certain fields of the sciences. As Peters (2013) describes, many scientists still feel they are communicating to 'outsiders' when dealing with the mass media.

Important for Francesca then is the strength of her scientific background, enabling her to establish credibility within the scientific community[70]. As Dunwoody (2004) outlines, some form of science training is a valued part of a science journalists 'tool kit', but not essential. In fact, Dunwoody (2004) argues such formal science training/education can have positive and negative effects on the reporting of scientific information. While science trained communicators can help achieve accurate and timely discussions of science in the media, the danger is move towards popularisation of science, with such scientists turned communicators coming from an advocacy rather a critical perspective. While this may be the case within scientific journalism, within scientific public relations, this advocacy stand point is often desired. As such, it was important to try and define Francesca's role.

Starting with Fahy and Nisbet's (2011) typology, Francesca clearly fulfils the role of 'Conduit', breaking down complex information for a non-expert audience (*The Bulletin* is aimed at CERN staff, researchers and fellows), and 'Curator' in putting *The Bulletin* together. With her work focused specifically on CERN, Francesca could also be seen as an 'Advocate', having an important scientific public relations function. Yet this function goes

[70] Francesca studied physics at postgraduate level and spent much of her physics career at CERN.

further. As Kallfass (2009) describes, internal communication is an important but often overlooked aspect of scientific public relations, as effective internal communication helps provide effective external communication with other stakeholders. The importance of the CERN Community is outlined in CERN's 2012-2016 Communications Strategy (CERN, 2011), where the group aim to engage in order to motivate people to communicate and foster a sense of belonging. Effective relationships are therefore needed between CERN researchers and the Communications Group, with appropriate channels open to allow for these groups to connect with each other.

With *The Bulletin* a well-established publication, and the CERN community seemingly willing to provide stories and information directly to her team, Francesca becomes a gatekeeper of news and information within the group. Shoemaker *et al's.* (2001) description of a gatekeeper in the early days of the digital age provides a simple description of a gatekeeper as an actor who selects, transforms and disseminate information to particular individuals or groups. In a networked digital age, Barzilai-Naho (2009) hints that the role of the gatekeeper varies depending on the stakeholder they are interacting with and the context in which they are in. Barzilai-Naho (2009) outlines the numerous activities of such gatekeepers, including the selection, addition, withholding, channelling, shaping, manipulation, repetition, timing, localization, integration, disregard, and deletion of information. Within networked organisations, multiple gatekeepers can exist, controlling their own gates with their own gatekeeping mechanisms. Francesca may well be one gatekeeper within the group, with *The Bulletin* her primary gate. In this respect, the notion of actors as gatekeepers in the Miller *et al*. (1998) Circuit of Mass Communication and in the process of scientific mediation needs to be rethought to demonstrate the distributed nature of this role in the digital age.

5.4 Head of Press

The day spent with Gerard, the Communications Groups Head of Press, was particularly quiet. It was very much an office day, with Gerard catching up with emails, making phone calls and preparing an upcoming Press Release. Despite being quiet, it was also one of the hardest days to follow. Over 80% of Gerard's phone calls and conversations with colleagues were in French, making the tracing of various communication activities difficult as I am not a French Speaker. I therefore relied heavily on the interview to gain a deeper insight into Gerard's communication and working practices.

As Head of Press, Gerard fulfils a number of different roles. His primary job is to manage the Press Team, as well as meet with journalists, prepare Press Releases and answer requests from journalists. In this respect Gerard often acts as spokesperson for CERN in interviews and statements, representing the organisation. In doing so, Gerard must know the views of CERN on various issues.

> ”So part of this is to really understand what the situation is in any matter [regarding] the lab, and understanding very well what is the political view of the Director General [DG] on all these things. Not only the DG but all the directors. [We] have someone in charge of International Relations, knowing the different

> relationships with the countries. Sometimes we have sensitive issues to deal [with] so we need to know what the status is, what could be a statement for any kind of problem."

While Gerard's days can vary quite a lot, meetings often form a major part of most of his days.

> "I would say I spend half a day in meetings. Can be meetings with management, meetings with different people from the Press Office for managing things or meetings on any project that can have media related activities around. After that the rest of the day is being on the phone with many people, answering emails, keeping in contact with people. I need to also write many things, often the Press Releases are written by myself and then in that case I need some quiet time to read."

When needing a quiet space to write or during phone conferences, Gerard will close the adjoining door to the main press office. The rest of the group know this means he is not to be disturbed.

5.4.1 Gerard's Day

I met with Gerard at 9am in his office, located adjacent to the main Press Team (f in Appendix A). With no meetings planned for today, Gerard aimed to spend the day catching up on emails and preparing Press Releases. As he explains, Gerard often spends his Thursday in such a way as he is normally out of the office on Wednesdays fulfilling other commitments.

> "Well I travel every Wednesday, I go to Paris, I have responsibilities at a university there, so very often on Thursday I have a few emails that are pending, so if I don't have many meetings I try to go through these because sometimes they are important. The most important ones I try to manage, but in that case less important things I will just forget, so I try to clean up a little bit. Yesterday was not a day with many meetings, so it was good to have a rest, a recovery day."

One of Gerard's main priorities for today was to prepare a Press Release[71] about tentative plans for a new machine to be housed at CERN. A Press Release was being put out to outline CERN's long-term plans, including a study into the feasibility of a new 80-100km circular collider. Although just at the idea stage, the team felt the needed to make people aware, especially the local community, and start the discussion early. Exploring this process with Gerard provided a useful insight into the decision making process of the team.

> "It's just a study to see what is feasible, how much it would cost to do that, but still as soon as you start such a process you can't hide it, not in the time of social

[71] CERN Press Release, 'CERN prepares for its long term future', http://press.web.cern.ch/press-releases/2014/02/cern-prepares-its-long-term-future, last accessed 21.01.2016.

> media. So we knew from the beginning we would need to communicate on that, but at which level you do that, is it worth a Press Release or do you manage it in another way? So it was discussed, I was not in favour of a Press Release for many different reasons, and actually Corrine who is in charge of Local Communications, was pushing for a Press Release for good reasons. We discussed it and it was decided okay lets go for a Press Release […] it will not be easy to manage because we have to manage the local level and international level, these are two different things, and sometimes it's not that easy to connect the two levels. In the case of this big thing, we don't want people to think we are starting to dig holes, new tunnels of 80km yet."

In advance of the CERN Press Release, the Head of the Relations with the Host States Service[72] was planning to send out a letter to the relevant local authorities informing them of the upcoming Press Release. Gerard had also arranged for a local journalist to produce an article about these plans, which he hoped would influence other journalists.

> "So we said okay we will go for a Press Release, but we will warn the local authorities by a letter just before. So on Monday we will have a letter going out to all authorities, officials from the local area, saying okay you may learn about

[72] Relations with Host States Service, http://hoststates.web.cern.ch/hoststates/en/Welcome.html, last accessed 21.01.2016.

> this, we are just doing a study, it's just a study. In parallel we invited a local journalist, respected newspaper in Geneva, and he is preparing a paper ready on that, and we know him very well so we know it should be serious. I pushed for that because I know journalists copy from what they read elsewhere so I want to have at least one good article out in a serious thing, so if the others want to write something they will read this first, and even if they don't understand the whole Press Release, they will manage."

A great deal of Gerard's day was spent coordinating with CERN's Host Relations in putting together the Press Release and letter. The majority of this coordination was done over the phone and by email. They were able to send drafts of the Press Release and letter to each other via email then discuss changes and make arrangements over the phone.

> "This morning I had three calls with the Head of Relations with Host States, because he is in charge of writing this letter. We tried to synchronise the wording of the Press Release and the letter so he said okay, I have the Press Release I will draft something and send it to you. […] At some point it's easier to be on the phone and say okay this thing no, this thing yes, and how we really organise with the DG […] I could have done it by email but it would have, I would have to wait for the answer and all that, actually I lose time with emails in that case."

When it comes to communication, Gerard relies on the phone quite heavily. For him, the phone has numerous benefits over other forms of communication. When dealing with potentially sensitive information, emails are not necessarily ideal. As one of the newer members of the group (taking over from David five months previously), the phone is also an important way to build relationships with journalists and other media.

> "If it's really urgent or if it's about building a relationship I go through the phone, that's the point. If it's not that urgent if it's not about building a relationship, email is fine."

> "Sometimes with things I don't want to write, sometimes it is confidential, so even with journalists there a sometimes things you don't want to write, you can say something on the phone, but say there is something coming out, writing it is a different thing."

Gerard has also embraced numerous digital technologies, especially social media, within his communication and working practices. During my observations, Gerard regularly used social media, primarily Facebook™ and Twitter™.

> "I use Twitter™ quite a lot because I manage a few accounts for professional reasons. I also use it to track a few trends sometimes […] It can happen that I check what is happening, could happen […] when it goes out I check what is happening on social media on the same time I track the coverage."

Gerard also uses social media in more novel ways, including to create interest in particular stories and to connect directly with his audiences, especially journalists.

> "I discovered it was a very powerful way to build a relationship with audiences and in particular with journalists, because many of them are on social media, at least Twitter™. I remember for CNGS[73], for instance, I sometimes could track discussions between journalists about what was happening at CERN, then I could enter into the discussion, and okay this does not happen every day, but I think we could use it more for this. […] When we had this very big story about neutrinos coming faster than light for CNGS I triggered an interest from the biggest newspaper, *Le Monde*, just sending a tweet saying okay we have something, if you want to know more just call me."

Using social media in such a way allows Gerard to connect directly to external journalists and media professionals.

5.4.2 Summary

While the use of language in Gerard's day was difficult to follow, the observations still proved useful, especially when it came to the use of digital technologies and the activities he undertook.

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[73] CERN Neutrinos to Gran Sasso, http://home.cern/about/accelerators/cern-neutrinos-gran-sasso, last accessed 21.01.2016.

In terms of organisation, the Press Office is well established within the Communications Group, as outlined in the pilot study (Chapter 4, Section 4.3). A great deal of focus has been placed in the building and maintaining of relationships with the media, a key actor in Miller *et al*'s. (1998) Circuit of Mass Communication, by strengthening the Press Office. The Press Office therefore achieves well at Keyton's (2005) basic level, with the role of the Press Office and their intended audiences well understood by the group. Issues may well arise however at Keyton's (2005) process and subjective elements. While the Press Office has well established and defined external communications channels to communicate with external journalists and media professionals, internal channels between the rest of the Communications Group and the broader CERN's community are not as well established.

The observations also provided in insight into the Gerard's role as Head of Press and the broader role of the Press Office. Using Fahy and Nisbet's (2011) typology of science journalists, Gerard fulfilled the 'Conduit' role through his production of Press Releases aimed at a none-scientific audience, as well as 'Agenda-setter' through his interactions with external journalists. Yet, Gerard spoke of the Press Team as having a broader public relations role, as such fulfilling Fahy and Nisbet's (2011) Advocate role. As Borchelt and Neilson (2014) describe the use of public relations activities to develop relationships with publics and interested parties, in order to gain and maintain support for the work of the organisation. Within this case study, Gerard undertook a number of public relations activities to build and maintain relationships with two key stakeholders, the local community[74] and the media. Putting out the Press Release regarding a potential new machine and contacting local authorities were specifically aimed to inform/reassure local communities about what was coming up. A local journalist was also brought in to make sure articles were present in local newspapers. Within Borchelt and Neilson's (2014) levels of public relations, this approach could achieve well at the *Programme* level, as the article is likely to be picked up by the programmes intended audience, the local community. Such activities could be seen as examples of 'upstream engagement' (Wilsdon and Willis, 2004), where discussions around complex scientific issues are initiated with publics in the early stages of the research cycle.

Throughout the observations Gerard's use of technology really stood out. Gerard seemed to really be utilising technology within his working practices in many different ways. The example observed of Gerard coordinating and cooperating with the Head of Relations for Host Nations demonstrated how the asynchronous nature of emails can cost time, with synchronous communication provided by the phone speeding things along, while Gerard has also used Twitter™ to strategically engage with journalists directly to create interest in stories.

[74] Here, the local community can represent a sub-section of the 'Public' in Miller *et al's*. (1998) Circuit of Mass Communication.

Technology was also important when it came to openness and dealing with journalists. For Gerard, the phone was a more appropriate tool when dealing with sensitive information, more so then email. Gerard also showed that building relationships with journalists is still important in the digital age, with digital technologies such as Twitter™ (along with the phone) providing the channels through which to do this. Such 'networking' practices are a key feature of digital scholarly practices (Palmer *et al.*, 2009)

5.5 Head of Communications

Once located along the 'communications corridor', David has recently moved up to the third floor of CERN's Main Building (j in Appendix A), away from the day-to-day work of the Group. Previously, David was in the heart of the Press Office, writing Press Releases and dealing with media requests. Now, David has moved up a couple floors to allow him to manage the group more effectively and deal with some of the behind the scenes issues.

> "I'm spending more time managing the group […] My writing is now limited to writing for the DG […] Increasingly, my meetings are on group management issues, which is a good thing because the group, one of the challenges I've had with the group is that it hasn't been managed because I couldn't find the time to do that."

Many of these managerial issues revolve around the group's resources, whether it's finding resources for projects, organising personnel or establishing the group's budget.

When talking about the life-cycle of their activities, David outlines the importance of establishing continual support and resources, using their work with the local primary education system as an example.

> "We've engaged with the whole education system, but really focusing on primary education as that's what they've [the local community] asked us to do. We've done that with somebody attached to the French Education Ministry, but the way CERN employment laws work is that from our side they can only do that for three years. So she is going very soon. The Education Ministry were quite happy for us to continue, but CERN's rules don't allow it. So were trying to figure out how to do that. We are going to have to make some tough decisions if we can't find the funds, the resources inside CERN that would allow us to continue. If we don't continue the things we've established then from a reputation management perspective it's worse than if we had never started it. So that's where we are, it's been a challenge, and I spend a lot of my time dealing with that kind of issue."

David explains that the local community is a key stakeholder that the group is trying to reinforce communications with through such programmes, and 'scientific tourism' events, such as ‘Passport to the Big Bang’[75]. These events often come at the request of the local community.

5.5.1 David’s Day

As I arrive at his office at 8.30, David is already in his first meeting of the day with Natalie, a member of the group’s multimedia team. This meeting is primarily about management of audio-visual resources and how they deal with requests from CERN staff and researchers.

> “There’s a mentality at CERN that this is a service and if you want something you go in and they [The Multimedia team] provide it. So Natalie, who’s quite new, is finding all these people saying, ‘I need a film today’. We are having to say, ‘you can’t have that, this doesn’t fit our communications goals, therefore you are on your own’. What we are doing is saying, ‘Here’s a camera, this is how it works, and off you go. Bring it back when you are done’.”

The meeting concludes at 9.00 and we are straight out the door and climbing the managerial stairs to the DG’s office and David’s second meeting of the Day. This meeting is all about the 60th anniversary and what CERN are going to do to celebrate. They are

[75] A ‘scientific tourist trail’ around the local area, following the route of the LHC ring with various exhibitions located along the course, http://press.web.cern.ch/press-releases/2013/05/cern-inaugurates-scientific-tourist-trail-passport-big-bang, last accessed 21.01.2016.

trying to organise a joint event to be held with UNESCO[76]. The DG wants an exhibit to be put together for a political audience, as well as a photo exhibit that could be used for a public event. David and the DG discuss who should be invited, mainly focusing on science ministers from CERN member states.

With the meeting overrunning, David sends a text message to his colleague saying he is running late for their meeting.

> "If I'm out of the office I will use SMS[77]. If I'm in a meeting that's over running I will send an SMS. If I sent it to an email they might not necessarily see it."

Once the meeting with the DG finishes at 9.50, we are straight off to another, the third of the day. This meeting is with a member of the CERN Protocol Office about a member of staff who has been working part-time in both the Communications Group and the Protocol Office. David wants to take her out of the Protocol Office and give her a full-time role in the Communications Group, dealing with administrative matters and providing an extra body.

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[76] United Nations Educational, Scientific and Cultural Organisation, http://en.unesco.org/, last accessed 21.01.2016.

[77] Short Message Service

By 10.20 we are back in the office and David can begin managing his emails. With the sheer volume David receives, it is important for him to stay on top of them. David manages his emails in multiple folders saved onto his laptop.

> "I try and leave an empty inbox every night before I go home. But I have, I cheat somewhat, in that one of my mailbox folders on my machine is called current mails, so these are things that are pending. I try to keep that below 50, but I rarely manage to keep that down. Then for everything else I have a separate series of folders that I file into. So I do that. I get a lot of junk so there is a lot I can just delete straight away, but you still have to look at it. And there are things that come in that in an ideal world I will be looking at more then I am […] There are things that I file away very quickly that in an ideal world I would spend more time on. If not me then somebody else."

When in the office, David uses a docking station and his laptop rather than a desktop computer. This makes it easier for him to take his work with him when travelling.

> "I have a laptop connected up to a screen when I'm here, then when I'm travelling my laptop is with me so all of my email is with me when I travel, my archived email. So I don't miss not being online. When I travel my inbox on my machine is out of synch with the inbox here, but it synchronises itself very well. If I file away all of my things in my inbox when I'm offline then reconnected, it gets it, which I was quite impressed with."

At 10.35 David has another meeting, this time with a new member of Human Resources who wants to check in with David about his group. I was asked to leave part way through this meeting (for roughly 15 minutes) so they could discuss a particular issue with one of David's group.

The meeting finished at 11.10 and David goes back to managing emails and working on various documents. Once up-to-date, David starts working on a talk he's is going to give the following week at the annual AAAS[78] conference, while checking emails and keeping an eye on CERN's social media activities. Along the way a member of the CERN Press Team drops in to ask David about a media request they have received[79]. A media group has made a request to come and film at CERN, but in an area the Communications Group don't have access. David tries to make a phone call to deal with the situation, but is unable to get through. Instead, David sends an email.

A little later David receives a phone call regarding the employee that shares her time between the CERN Group and the Protocol Office. David receives confirmation that she can switch role. Once off the phone, David goes to see his colleague in the Protocol

[78] The American Association for the Advancement of Science, http://www.aaas.org/, last accessed 21.01.2016.

[79] The majority of this discussion (two minutes) was carried out in French so difficult to follow.

Office to talk about the call. David often prefers to talk to people face-to-face rather than email or phone.

> "I was on the phone about this, about the person we discussed with Amy [Protocol Office] and I will also nip out of the office and talk to Amy because there's no point in sending an email because she's just there. I would prefer for people who are here, personal contact rather than by telephone. Face-to-face rather than emails. Emails and telephone are for covering distances."

At 12.15 we break for lunch, reconvening at 13.05. Once back in the office, David again manages his emails and works over his talk before heading to his next meeting at 13.15.

We arrive at the CERN restaurant at 13.20 and meet up with the organiser of an upcoming lecture at CERN about science and society. David talks about organising speakers for the event and promoting it through the Communications Groups channels. During the meeting, David tries to look at the draft programme on his phone, but is unable to open the document.

The meeting finishes at 13.40 and David returns to his office where he makes notes of what he needs to do following the meeting. David uses physical post-it notes to keep track of current tasks. David then returns to managing emails, where he discovers his last meeting of the day has been cancelled. This frees him up to work through a number of other emails.

A big part of the afternoon is spent setting up meetings with the DG with regard to a number of fundraising activities. David makes a phone call to the DG's secretary regarding a visit to the Science Museum and the Wellcome Trust. Five minutes later, David has to phone the DG's office again to check his availability to host a number of CERN funders who will be visiting the site.

> "I phone the DG's office a lot to find out what the DG is up to, when he's available, what times in his diary, etc."

From 15.00, David spends some time watching a number of short films made about various people at CERN[80]. There were eight videos in total, each between two to five minutes long. David made notes about each video, mainly checking for accuracy, and emailed his feedback to the producer of the videos.

5.5.2 Summary

Once again I had a number of questions I wanted to follow up with coming out of the observations. Firstly, I wanted to know how the physical move from the heart of the group, particularly the Press Team, to three floors up has affected his relationship with the group. I was wondering if this physical separation had created new problems amongst the group, especially in terms of communication. I was also wondering how the

[80] Example of one of the videos watched during the observations. 'CERN People: We are the memory', https://www.youtube.com/watch?v=NX0cu52d-QE, last accessed 21.01.2016.

group had taken to this move, and how not seeing David affected them on a day-to-day basis. Such separations can cause problems at Keyton's (2005) subjective and satisfaction levels through a breakdown in the inter-relationships between manager and members of the group. As discussed in Chapter 2, Section 2.2, Hoogervorst (2004) describes how communications within an organisation can be ineffective when managers are isolated from the rest of their unit.

Having moved away from the day-to-day running of the Press Office, where he was once in charge of writing Press Releases and editorial side of the group, Fahy and Nisbet's (2011) typology doesn't directly apply to David's role[81]. Yet, a number of public relations functions were observed. David is in charge of managing the CERN's 'trust portfolio', influencing each of Borchelt and Neilson's (2014) functional elements of public relations. It's David who decides where the funding for specific programme level components of the Communications Group is distributed. In this respect, David ultimately has the greatest impact at Borchelt and Neilson's (2014) functional level through this control of the overall public relations functions of the group.

The use of communication technologies were also a key feature of the observations. As Mark and Poltrock (2004) describe, the adoption of communication technologies will be

[81] Although some activities, such as the writing for the DG and fact checking videos, touch on aspects of Fahy and Nisbet's (2011) 'Conduit' and 'Convenor' roles.

influenced by various factors, including the organisational context, an individual's role, the individual's needs and the specific task. Throughout the day, David utilised both analogue and digital technologies when communicating. In terms of digital technology, managing emails formed a big part of David's day. To deal with the amount he receives on a daily basis, David has set up a series of folders to manage his emails and make them easier to work through. Technology has also allowed David to manage emails while on the move, which, as Larson *et al.* (2008) describes, reduces the isolating effects of travelling. For more immediate communications when away from the office, David also uses text messages which, as Nardi *et al.* (2000) describe, can be used as a channel to exchange content and coordinate information with an individual quickly and effectively.

While digital technology formed a major part of David's communication practices throughout the day, the phone and face-to-face were also used extensively to communicate with colleagues. As Munkejord (2007) describes, face-to-face is often the preferred communications method when distance is short and/or a tasks needed attention urgently. As David describes, he prefers to go and speak to nearby colleagues face-to-face, while using the phone and email to cover distance.

5.6 Web manager

Along the corridor primarily inhabited by writers and press officers lies the main technical unit of the Group, the Web Team (h in Appendix A).

The team of three based in this office are responsible for all the technical aspects of the Group, including maintaining CERN's web presence. Within the team is Liam, the editor of the website, who plays an intermediary role between the editorial and the technical aspects of the Communications Group. Liam is the only member of the web team to attend the weekly editorial meeting, feeding back to the technical team. This allows the technical team to plan and prepare for updates and how they can be presented on the website. The technical elements behind the presentation are handled by the newest member of the team, Steven, the programmer and system administrator. One of Steven's main jobs is to manage repositories for the computer code produced for the various projects. Leading the group and the main focus of my observations is the Web Manager, Ben, whose role covers both the editorial and technical aspects of Liam and Steven.

Office space is limited, with the team crammed into a room that realistically should only house two. Taking a seat that blocked the well-trodden path to the offices coffee machine, it was hard not to feel at least slightly in the way when I first arrived. This feeling was further confounded as I knocked over a bike that until then had been peacefully leaning against a wall, sending it crashing to the floor.

Despite my early indiscretion, I was made to feel extremely welcome by the team. In the time I spent with them, they seemed to be a close group who clearly worked well together. Much of that seems to be down to Ben's management of the team. Ben has implemented numerous means by which each member can have their say on the tasks that need to be undertaken. The team holds a planning meeting every Monday to figure out what is coming up, review what still needs to be done and to create a joint task list. Deciding the priority of tasks is a democratic process within the team, using a set of cards with various values to indicate the priority of the task. Each of the team can estimate the value of the task and fully discuss their thoughts and opinions.

When a task is agreed, it is written on a post-it note and stuck on a chart on the back of the office door. The chart has three columns, 'up next', 'doing' and 'done' which the note passes along as the task is undertaken. Mirroring the chart on the door is an online system, JIRA[82], that documents and tracks these tasks so the team can see who is doing what and what stage it's at.

> "It's really important for my team to leave a documentation trail. If one of us dies or someone new joins the team there's a lot of stuff in there, so a lot of our day is writing down what we are doing. That's particularly important for code."

Although now managing the Web Team, Ben explains how he was originally hired as a writer for the website. During his time, he soon found the web at CERN lacked a proper infrastructure, with multiple websites having been set up by various people at CERN.

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[82] JIRA is the external software used by CERN as there issue tracking service, http://information-technology.web.cern.ch/services/JIRA-service, last accessed 21.01.2016.

> “I've been working closely with IT to set up an infrastructure so that we have content management system to manage our websites, so about two years ago IT launched a service for content management called Drupal[83], and about 500 websites at CERN now use it, so part of my work is still kind of nurturing that infrastructure.”

One of Ben's major projects was to completely rebuild the CERN website. Previously if you visited 'cern.ch' from inside of CERN, you saw one version of the website, but if you were outside of CERN you would see another version of the site.

> “So there was this perception we had two audiences, so I've rebuilt a single website, and in the process of that we've looked at who are the audiences that this is serving.”

By doing this, Ben has moved away from the groups defined audiences[84] and looked directly at who was coming to the website, basing their audiences on real traffic. From this, the Web Team identified four overlapping core groups, the general public, students

[83] Drupal is an open source content management platform that allows people to build websites and applications, https://www.drupal.org/, last accessed 21.01.2016.

[84] See Chapter 4, Section 4.1.2 for a list of audiences defined by the CERN Communications Group.

and educators, the scientific community and the CERN community[85]. Of these groups, students and educators generate the greatest proportion of traffic.

5.6.1 Ben's Day

Joining the team at 9 am on the observation day, Ben was already half way through a meeting with a CERN VIP and Protocol Officer about photos being used on the CERN website. Ben was concerned by the number of photos from various visits that had been taken and uploaded to the web server with no information as to who's in the photo, when and where the photo was taken.

Following the conclusion of the meeting at 9.30, Ben starts work on new guidelines for the uploading of photos to go with the current writing guidelines the Group provide[86]. These were designed to encourage effective naming, captioning and sizing of images across CERN. With Liam out of the office, Ben creates a ticket for JIRA requesting these guidelines be produced. On arrival, Ben sends Liam the ticket and explains to him directly in more detail what is needed. Once agreed Ben writes the task on a posted note and sticks it in the 'doing' column of the door chart.

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[85] These audiences could be broadly categorised into 'Publics' and 'Scientific Institutes' within Miller *et al's.* (2008) Circuit of Mass Communication.

[86] CERN, Writing guidelines, http://writing-guidelines.web.cern.ch/, last accessed 21.01.2016.

Following another short conversation with Liam, Ben settles down to his emails. Emails form a large part of Ben's day, being almost overwhelmed by the number he receives.

> “Emails are a real problem. I get a couple of hundred emails a day, so I kind of scan them, I don't read them. I've got some automatic filters on my email, so if anything comes from the service desk I can see it, if anything comes from our internal teams ticketing system I can see it and I can filter, so the first thing I do with email is do a quick scan of what is spam, I do get a lot of spam, I probably get about 50 a day […] And as I'm scanning I will make a note in my book, I have a little system where anything with a star is an action within the boxes. So although it’s on the screen a lot of my organisation is done on paper.”

One of the emails Ben has received is about arrangements for a new top-level domain for CERN. Ben starts to reply to the email but finds it difficult to articulate everything he wants to say. Instead, he tries to phone in an attempt to speed up the process.

> “It’s an iterative thing [use of email], if you need someone to come back and say the problems this and you need to get back to them, there's an exchange, pick up the phone. It would take 10 emails when it could take 10 seconds on the phone.”

With no answer on the phone, Ben resigned himself to composing the email. Five minutes in, the editor of the *CERN Courier* stopped by ahead of their scheduled meeting with Ben. Wanting to get this email sorted first, he says he will meet her in the restaurant in ten minutes.

At 10.10 with the email sent, we head down to the restaurant to Ben's second meeting of the day. After grabbing teas and coffees we meet with the *CERN Courier* Editor. This meeting primarily focuses on how the group gather stories from various external contributors (researchers, engineers, etc.). The *CERN Courier* Editor doesn't want external people writing articles/stories themselves. Instead she wants them to make suggestions while the Communications Group writers put it together. In response, Ben plans to create an email address or a website where people can send in their ideas which can then be picked up by one of the writers. Ben explains later this will work much like the ticketing system they use in the web team, whereby you can track what tasks/stories have come in and who has taken them.

With ideas finalised, the meeting ends at 11.30 and we head back to Ben's office. There Ben has another check of his emails, before discussing with Liam the setting up of a service account that allows people to submit ideas for articles they want written. Ben sets up the account 'comms-request' and asks Liam to include it within the writing guidelines.

With a busy afternoon ahead, Ben goes for an early lunch at 11.45.

Returning at 12.40, Ben first stops by a colleague in a neighbouring office, confirming that they were still on for their meeting that afternoon. Back in his office, Ben checks through his email before picking up one of the tickets that needs doing on JIRA. The task was a programming operation, trying to fix aspects of the CERN website. The main problem was the look of the website on mobile devices, in particular the sizing of the text of articles.

Once fixed, Ben sends the code he's written to Steven to store it in a repository.

> “Every time we make a change to the code, you submit it to the repository, make a comment and then if you break the code you can always role back to another version.”

After a further chat with Steven, Ben sends a message on Skype™ to an external colleague that works for a UK company that helped create the new CERN website. Ben describes them as an extension of the web team, and will often use Skype™ to stay in contact.

> “So after we have the planning meeting on a Monday, I will have a planning meeting with the person on their side through Skype™.”

Skype™ provides numerous benefits for Ben and his team, allowing them to quickly and easily contact people outside of CERN.

> “If you want to phone someone and its overseas you've got to go through the switchboard. I don't know if you have tried it, but it takes two minutes or so. Skype™ is nice as well because you can just ping someone and say, are you free to chat, yes or no? By the time you are on the end of the phone, you have already interrupted them. So it’s less interruptive.”

At 13.20, Ben gets ready to head to his next meeting. Before leaving he moves tasks from his task list from 'backlog' to 'doing' so the rest of the team is aware of what's being done.

We head around the corner to the meeting room. The meeting is with another communications officer, Mary, the Knowledge Transfer Communication Manager. The meeting is primarily about the CERN web and policies surrounding setting up new domains. Ben wants more management in terms of who can create domains and the life cycle of content.

> “[There are] 17,000 websites at CERN. Anyone with a CERN account, and there are 46,000 account holders, can sign-in and create a website. If you've got a CERN account you can sign in and you can set up a website called CERN News and journalists won’t be able to tell that it is your website they might think it’s official. So we have a big problem with trust, trying to figure out who has published stuff, is stuff old, what is the real source of information, and this is not just communication stuff this is operation stuff.”

> “We need to look at these questions, who can create a website under what conditions? When does a website die? Who gets control of the URL space? What are the writing guidelines? What are the guidelines regarding information at CERN.”

But as Ben acknowledges, creating such policies at CERN requires a careful consideration.

> "It's a balance, not kind of breaking that freedom, but also trying to manage, not control but manage it a bit better […] we can't change, [...] we are not going to say this is the way it's going to be."

Towards the end of the meeting, Ben and Mary set up a Skype™ meeting the next day when Mary is off-site. Ben checks his phone and enters the details into his calendar that syncs with his digital calendar.

Returning to his office at 14.10, Ben goes back to managing his emails. He has a further chat with Liam about the communications request form. They decide to create a box on the website where people can request things, such as photographs, etc. to be taken. Ben creates the ticket and sends it to Liam, then proceeds to stick a post-it note to the door chart.

Over the next hour, Ben spends his time sorting through emails and planning for his final meeting of the day. The meeting involved various members of the Audio/Visual team (another team part of the Communications Group) and focused around plans for the 60^{th} anniversary. This meeting was almost completely carried out in French, making it difficult to follow. Throughout the meeting, Ben used pen and paper to make notes about what was being said.

5.6.2 Summary

Following on from the observation day, a number of elements were identified that I wanted to further explore. First off, I wondered how they fitted in with the rest of the Communications Group. As a technical unit within the Group, I wanted to further understand the role they play and the relationship with the other members in the group. It seems rather than producing content for particular audiences, the team is focused on the platform through which audiences can obtain information, providing specific sections with relevant content. While Ben was originally hired as writer for the website, neither Fahy and Nisbet's (2011) typology of science media professional's or Borchelt and Neilson's (2014) functions of public relations were applicable to this case and his current position as Web Manager. Instead, Ben and his team fulfil a facilitator role, providing the space and technical infrastructure through which the group serves many of their audiences.

Despite being near to other members of the Communications Group, the Web Team is still rather isolated, being the only technical unit, with a lack of interaction with the rest of the group. Only one member of the Web Team attends the weekly editorial meeting, who then feeds back to the rest of the team. Such separation may cause an issue at Keyton's (2005) process and subjective levels, where a lack of understanding as to the role of the Web Team may create tensions with other members of the group.

The use of technology for communication and working practices was the big theme of the observation. As Mark and Poltrock (2004) outlines, the adoption of communication technologies within organisations can be influenced by a number of factors, including the organisational context, an individual's role, the individual's needs and the specific task undertaken. As Ben describes, emails are real problem for him, receiving hundreds on a daily basis. In order to manage them, Ben has established a process of filtering emails into separate folders set up on his mailbox. In this respect, Ben is able to utilise features of the technology to minimise the negative effects of information overload.

This case study also provides an interesting demonstration of communication usage patterns and how technologies can be used synergistically with each other. Failing to reach his colleague by phone, Ben returns to email to contact them. Rotating between multiple communications technologies in this a way increases the chances of the communication being successful. Ben also uses Skype™ and its Instant Messaging feature in a similar fashion. Ben can use instant messaging to coordinate further communications without interrupting the recipient i.e. asking if they are free to chat before phoning or initiating a Skype™ call. Similar findings were seen in Nardi *et al.* (2000) where instant messaging was used as a channel to exchange content and coordinate information quickly and effectively.

Another interesting aspect of Ben's and his team is their effectiveness at organising and planning their work loads. Ben has set up what Munkejord (2007) describes as 'puzzle zone practices' within his team, with weekly meetings held an hour after the wider Communications Group editorial meeting, where the team can discuss what is coming up, review ongoing tasks and work together to create a joint task list.

Openness was also a big part of this case study, especially apparent in the meeting Ben had regarding web policies. Here, Ben is trying to deal with difficult questions of how to manage websites at CERN without proving too controlling. It appears Ben wants to find a balance between the previous 'do-it-yourself' attitude towards the web, and a more command and control model. Finding this balance is a key issue within the debate surrounding open/digital scholarship. As the like of O'Reilly (2004) and Weller (2011) describe, cultures of openness are underpinned by the infrastructures and tools available that allow people to contribute[87]. Openness within organisations, therefore, requires not just the technologies that allow participation, but the suitable policies that facilitate, perhaps encourage, such practices.

5.7 Experimental Physicist

It was hard for me to know what to expect when preparing to spend a day with an experimental physicist. I was half expecting hard hats in underground tunnels, flipping

[87] O'Reilly (2004) uses the term 'architecture of participation' to describe systems that are designed for user contributions.

endless switches on monstrous machines. On this occasion though the hard hats were hung up, with laptops and meetings the order of the day.

As a physicist, Emily argues working day rarely equates to a 9-5 job, with her routine varying depending on the stage of the experiments. When the machines are running for example, Emily could often be on call 24 hours a day for up to two weeks at a time. This is often in order to coincide the publishing of results with big physics conferences.

> "When we are running there really are no weekends. When I was running you would be on call, so that's a week or two weeks, day or night, because we run 24 hours, so we can make Conferences. So ICHEP[88] just went, and like two months before that, evenings and weekend didn't exist, it's just this period of continuous working [...] but then it's flexible, so if you do that then after the conference you can be like right I'm going to have a week off, bye."

> "So when we publish that is generally when we give a talk at a conference, not all the time, […] but yes we are not just going to produce it and be like 'Oh there's a paper out', we will wait for a big conference, well get ready for one. So everyone pushes for ICHEP, and we aim for these big conferences, and then we give the big presentation, it gets published and then we, the news goes out."

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[88] International Conference on High Energy Physics, ICHEP, http://ichep2014.es/, last accessed 21.01.2016.

But Emily now leads a double life. Not only is she an experimental physicist, Emily recently took up a position as ATLAS 'Education and Outreach Coordinator', a role she shares with another ATLAS physicist. This coordination role is meant to be carried out 50-50 with her physics role. Yet as Emily explains, this is rarely the case.

> "It's supposed to be 50/50 [split between her physics and outreach coordination roles], but basically it means that during the day I get emails or I have to do tours during the day, it just eats into your time […] so it's very hard to sit down and get physics work done, so I've been struggling a little bit, but I'm sorting it out slowly."

Being new to this Role, Emily is still getting to grips with her new responsibilities and the new ways of working the job brings.

5.7.1 Emily's Day

I meet with Emily at 9.00 in the CERN restaurant before heading over to her office in Building 40, the building that houses many of the ATLAS physicists. Emily shares her office with five other ATLAS physicists, but on this day the big, bright office was noticeably empty. This is partially due to the nature of life as an experimental physicist.

> "I guess it's supposed to be 9-5, but it's definitely not. You are supposed to work 40 hours, but everyone works a lot more than that. The earliest most people leave is probably six which is quite early, most people will be here until seven, eight or nine. It's flexible though, you can take mornings off, as long as you

> haven't got meetings on and you get your work done, but we all do much more than 40 hours, we do a lot of hours."

Settling into her office, Emily's main objective for the day is to prepare for a presentation she has to make at the ATLAS Physics Plenary[89] meeting that afternoon. Emily is introducing the wider ATLAS group to a new channel through which they can disseminate their physics results. Emily and the ATLAS Outreach team developed the idea of 'Physics Briefs', summaries of physics papers aimed at wider audiences.

These Physics Briefs would be put together by the ATLAS Outreach Team and the relevant scientists. Emily hopes these Physics Briefs will help in the wider dissemination of the work done by ATLAS. Furthermore, Emily is hoping these Briefs could help improve the relationship between ATLAS and the CERN Press Office.

> "I felt like we weren't really communicating our results very well with the CERN Press Office, so this is part of what Physics Briefs can help do as well."

In her office, Emily has quite the technical set up. With two laptops, one split screened onto a PC monitor, Emily multi-tasks her way through the day, emails open on one laptop, creating slides on PowerPoint™ on the other.

[89] A weekly meeting held between members of the ATLAS collaboration.

At 9.55, once all of Emily’s laptops and monitors are up and running, Emily signs into a web meeting on one of her laptops, while still working her way through her slides. With the meeting due to start at 10.00, Emily is confused as to why nobody else appears to be online. She quickly checks her diary to make sure she's got the right time and date. Still slightly confused, Emily finally checks her email and realises the meeting has been cancelled, much to Emily's relief as she can now focus more on her presentation.

In making her slides Emily uses Google™ and Twitter™ to source images, as well as screen-grabbing charts and graphs from various documents. Splitting her laptop screen with a PC monitor allows Emily to source the image and drag it across to the monitor to place it into her presentation.

At 10.45, Emily phones one of her colleagues in the Education and Outreach Team asking about some statistics that have been put together about outreach at ATLAS. Emily wanted to clarify some of the statistics about social media that weren't clear to her. Emily’s colleague says they will look into it and call her back shortly.

Her colleague phones back ten minutes later at 10.55 after looking over the statistics. While on the phone Emily makes pen and paper notes (longhand), occasionally stopping to check through emails on her laptop. Emily and her colleague discuss which of the statistics are most interesting and would work well within her presentation. Agreeing on what to use, the call ends at 11.05 and Emily gets back to the slides.

A few minutes later, Emily again runs into problems with her presentation. She initially goes to send an email to her co-coordinator before deciding to phone him instead, asking him where the Physics Briefs will be going, if they will be on the ATLAS website, promoted through social media, passed to the Communications Group or all of the above.

The use of phone over email as the preferred method of communication is one of the biggest differences in Emily's use of technology between her role as a physicist and as outreach coordinator.

> "I use the phone a lot more, that's the main thing that's changed the use of the phone. I ring people specifically for communication; I don't actually ring people in physics because that's not how we do things. In physics were more Skype™ and email, but for comms and outreach it's the phone."

This doesn't mean that emails are not an important communicative tool for the outreach team. As Emily describes, the number of emails she receives has increased.

> "In outreach you get cc'd into a lot of things so in the first case anyway I personally get more emails, but then we have all these email lists, so ATLAS outreach coordination, ATLAS Press and ATLAS discussion. So say if our management is talking to the press we are cc'd so we know what's going on, it just means that there's loads of them, and you know I don't know what to do with them."

> “We get cc'd in a lot which is nice but sometimes I would rather just coordinate, just be like I want someone to look after that. Say for visits I don't need to see every single visit email. It would be nice to have a person who looks after visits, will make sure everything's working then I can just coordinate that. Otherwise, being privy to every single part of outreach, education, communication is a 100% job and I'm not 100%, so it’s too much. Emails are just impossible sometimes, they come in faster then you can reply.”

Once off the phone, Emily continues to work on her presentation before stopping for lunch at 12.20. On the way out, Emily receives a call from her colleague again asking her to send through the slides so she can check over it. Emily says she will send them through after lunch.

During lunch Emily meets with one of her PhD students from her home institute, who has become the main focus of her role as a physics researcher since taking the coordinating role.

> “The main thing at the moment is I have two students so they are my main concern. For three weeks I've said I can’t do physics analysis [because of the coordinating role], I keep trying and it’s just stressing me out and I just don't actually have the time. I have my students so I'm just now making sure they know what they are doing and following them, so that's my responsibility with my institute.”

> “I'm probably not going to do physics until ‘Run Two’, but that's fine, it gives me enough time to get everything organised, coordinate enough to get some more people doing some outreach work so I'm a bit freer.”

Emily's Ph.D. student is due to present some of her analysis at one of the upcoming ATLAS meetings. As one of her students, Emily encourages her to present her work as frequently as possible.

> “We have a meeting [with the Ph.D. student] with her analysis every Tuesday at five. It’s good to see her present every week, but it’s a lot of work, but she's a student so you have too. So she makes some plots, works out whatever she's got to do, she'll show it, and everyone will go, “Hmmm”, and chat about it and say, “Maybe you need to look at this, etc.” then she will go away and do it. Lots of people show results and stuff, and in the end we try and get it into a paper that gets published, so that's a lot of analysis.”

After a quick chat we head back to Emily's office at 12.50. On arrival she does a quick check of her emails before sending through the slides from her presentation to her colleague. While waiting for a reply Emily has a few conversations through Skype™ messenger. At 13.15 Emily receives feedback about the slides and makes some quick amendments before uploading the slides to the Physics Plenary Indico[90] event and heads to the meeting.

After some slight confusion over where we needed to be, we arrive at the meeting slightly late at 13.40. Settling in at the back of the room, Emily takes out her laptop to look over her slides while other presentations are going on, as well as to check her emails and send messages on Skype™. Emily is the third presenter at the meeting and at 14.20 heads up on stage to give her talk. She makes her way through it effortlessly, leaving time for questions at the end. During the question taking, one physicist asks quite a fundamental question that Emily purposefully avoids, passing it over to the host of the meeting. The question was simple, who decides which physics results are interesting and worthy of becoming Physics Briefs.

> “That's Physics Coordination[91], but the thing is that it’s very political. Outreach is a political nightmare and I never realised it was, which is why that question, I didn't want to answer because it’s coordination in charge and I didn't want to say something that implies something wrong […] I’m just very careful, so now if I'm asked a question like that I'm just like physics coordination will answer it. And

[90] Indico is an open source tool used to manage conferences, workshops and meetings, https://indico.cern.ch/, last accessed 21.01.2016.

[91] ATLAS Physics Coordination direct the physics research and set the priorities of the group.

> they get to choose and that's how they decide to do things, like I think we should do it for every paper [the briefs]."

> "There are the three main managers then there's Physics Coordination just below them and they basically decide how things go. But because it's a collaboration it's not a hierarchy they're not like 'This is how things are and that's the end'. Everyone has to be happy. That's why it's political."

One of the main concerns coming from other physicists in the room was the time demands putting the Physics Briefs together may take. As Emily explains, the time demands of engagement/publicity work more broadly are a big consideration when choosing to undertake any activity.

> "Everyone feels a bit like this, that you have to do it [outreach] on top of your work. You're supposed to do like 10% outreach stuff, but it means you're doing 10% less physics analysis, which means your work might be a bit slower then somebody else. It's a competition all the time in physics, so a lot of people don't like to do it at all, I really enjoy it, and I just do it anyway and I try to do my work and get it done as well."

Emily also explains how such work can be seen as damaging to a physicists career in the long run.

> "It's a bit dangerous. So the thing is outreach is good but you should only do 10% or 20% because we are physicists [...] It's dangerous for me to be doing so much [...] Loads of people will just think I do outreach so it's damaging, so when I want to apply for jobs they will be like 'oh yeah but she just does outreach', so it's actually dangerous, but I want to do it and it's interesting."

While being so heavily involved in outreach can be problematic, Emily is aware it does improve her visibility, which can be extremely important within physics, helping your name stand out amongst the thousands of other people in a collaboration.

5.7.2 Summary

After my day spent with Emily, I was interested in exploring a few topics in some more detail. First of all, I was interested in finding out more about her relationship with the Communications Group. As Outreach co-coordinator for ATLAS, I would have expected to see Emily at one of the editorial meetings, which are often attended by those outside of the CERN Communications Group. These would be useful opportunities for Emily to share information with the wider CERN community. A lack of interaction between members of the ATLAS Collaboration and the CERN Communications Group could cause issues at Keyton's (2005) process level, which could further impact on the subjective element and relationships across CERN as an organisation.

Openness and organisation were also stand out themes from Emily's day. The question asked during the presentation was a particularly fundamental question, who chooses what's interesting? From Emily's response (or lack of) during the presentation itself, leaving it to the organisers to answer, you could tell there was a conflict there between Emily and the people in charge. The organisation of the ATLAS, despite not being totally hierarchical, still impacts on level of openness.

I also wanted to find out how Emily's new role as Outreach Coordinator has impacted on her role as a physicist and what it means for her professional identity. As Whitchurch (2008) describes, public engagement and outreach efforts by organisations create what she calls 'third spaces' between academic and professional disciplines. These spaces are then filled by individuals who undertake both academic and professional roles. Whitchurch (2008) categorises these are *blended professionals*. Emily fits well within this category through her combination of role as an academic (digital scholar) within experimental physics, and as a professional within her outreach role. Within this outreach role, Emily can be seen to fulfil Fahy and Nisbet's (2011) 'Conduit' typology, through the creation of Physics Briefs which are aimed at non-specialists audiences. As Whitchurch (2008) describes, undertaking such roles can have both positive and negative implications for current and future careers. Such roles can help create unique professional profiles, but may also damage academic progress. Emily seems to be well aware of the dangers facing her, discussing the damage her outreach work could have on her career progression. Similar concerns were raised by academics within Watermeyer's (2015) study into public engagement practitioners within higher education. Here, Watermeyer (2015) describes how many academics view such work as less relevant and less influential to institutions promotional criteria and promotional panels. For those in the ‘third space’ (Whitechurch, 2008) within Watermeyer’s (2015) study, the undertaking of engagement activities had caused major shifts and reconfigurations of their identities, often away from that of academics and towards those of ‘para-academics’ (Macfarlane, 2011).

Emily’s use of technology also stood out throughout the observation day. With her new role as Outreach Coordinator, emails and the phone have become integral to her working practices. As Peters (2006) outlines, the various features of technologies will affect their suitability for specific tasks, along with the culture in which an individual works. With emails, Peters (2006) describes how they are able to support groups whose members are dispersed, allowing individual knowledge to be easily disseminated to a wider number of people. Yet, the day with Emily shows how this ease of distribution can create problems. Emily finds herself copied in on excessive amount of information, not all of which is relevant to her. As Emily explains, dealing with emails is difficult and she struggles to cope with the amount she receives, feeling the distribution of emails lacks coordination and targeting.

Another feature of emails that impacted on the way Emily utilises this technology is its asynchronous nature. During the observations, after running into an issue while putting together her presentation, Emily decides to phone a colleague rather than email. Here, the urgency of the task comes to influence which technology Emily uses, with the asynchronous nature emails not necessarily lending itself to dealing with urgent requests.

5.8 Theoretical Physicist

My final observation was with Eric, a Postdoctoral Researcher in CERN's Theory Group. Eric is a year-and-a-half into a two-year fixed-term contract, with his research based around high precision predictions for all types of LHC observables, focusing on calculating the cross section of Higgs boson decays.

As Eric explains, he doesn't tend to work a typical 9-5 day. Instead, he finds it hard to leave work at the office, partially due to the nature of theoretical physics and the work he does.

> "Sometimes you just sit at your desk for two or three hours with a piece of paper, try and solve a problem and maybe you've scribbled something down, but it's complete and utter nonsense. Then you may say time was wasted. If you are goal orientated then you haven't achieved very much but it seems to be part of the job in that sense. You may then come home and it's still on your mind and suddenly you get an idea, 'Oh this might work' and you try it out and you just can't leave it and the you just focus on it, and you get more done then than in the entire day at work. It doesn't really let you go […] I think the problems you are thinking about are so deep that that you have to go in all the way."

As a result it’s hard to establish how many hours he works, with Eric arguing that he finds it hard to switch off, thinking about work at all times.

5.8.1 Eric’s Day

I meet up with Eric at 11.30 as he arrives at his office. After dropping his bag and laptop in his office, we head up to the theory department to catch the end of a seminar held by the Higgs Cross Section Working Group, a group made up of experimental physicists from ATLAS and CMS as well as members of the theory community.

We arrive with the presentations having already begun. The meeting room is full to capacity as we try and squeeze our way through the standing crowd to the corner of the room, managing to perch on the corner of a table next to a row of fridges.

The presence of these fridges was the first indication this was less of a meeting room and more of a common room. During the presentations, people continuously wandered in, gathering lunches and warming them in the row of microwaves.

With the hums and dings of microwaves providing the soundtrack, we settle in for the final presentation that Eric has come to see. Throughout the presentation, a number of fairly heated debates flair up between members of the audiences and presenters. As Eric describes, conflicts are a common occurrences at meetings between theoretical and experimental physicists.

> "It gets very heated [the Group Meetings]. The kinds of people you find in theoretical physics are just, they all very smart, but they think they are even smarter then they are, and they like to be right. So they come up with smart things and sometimes other people disagree with that and then, it gets kind, it can become quite strong. Which makes it kind of fun I suppose. I've certainly had one or two debates or so at the Working Groups. It's actually quite fun."

> "Experimentalists try to be theorists and theorists try to be experimentalists. And we don't trust each other. That is the truth. That's just standard physics attitude, nobody trusts each other, and even the theorists don't trust each other. […] I suppose it's good in the end. It's good if everyone is a bit distrusting towards one enough because it means everything is cross checked, but if it's too much distrust it becomes counterproductive."

With the meetings over and tempers calmed, Eric starts talking with a couple of his fellow theorists that he is currently collaborating with. They decide to head back to Eric's office to talk over a paper they are working on.

Arriving back at the office just after 12.00, the three gather around Eric's laptop to look over the latest version of the paper that one of the group has emailed around. While looking through the document on the laptop, Eric and his colleagues make use of the most valued communication tool in his office, the blackboard. Throughout their discussion, each one of them takes turns writing and erasing equations, explaining their ideas and working through problems.

> "The blackboard is by far and away the best way to communicate ideas. I mean in a discussion it speeds things up a lot because you can just write things down immediately, but you can also get rid of it immediately and you can quickly just do a quick calculation. While you are talking you are writing down equations."

The blackboard is also used extensively in presentations within the theory department to great effect.

> "It's [using blackboards within presentations] much more fun, much more engaging because the presenter has to actually go through the process again and that means he is rethinking it, he is actually going through the path rather than just giving it from a book."

While the blackboard is the easiest way for him to share ideas when face-to-face with colleagues, Eric has embraced digital technologies to work with colleagues outside of CERN.

> "I'm using Skype™ a lot actually, to stay in touch with people, with collaborators who are not here, which for me at the moment is the case, most people I work with are not actually here, so I'm doing a lot through Skype™."

This is not without its problems though, with Eric finding it harder to communicate ideas through this medium in the same way.

> “I’m finding it very difficult to communicate ideas through Skype™ in comparison to if you are on the blackboard. But also it seems that, with Skype™ we also try, we type the equations through the Skype™ messenger, but they don’t look very pretty so people are ‘Oh God can you just write that up in La TeX[92] because I really can’t understand what you are talking about right now’. That happens quite a lot!”

After an hour of going over the paper, the group decide to head to the restaurant for a working lunch at just after 13.00, where they continue to talk over their work.

With discussions finished, Eric and I head back to his office where he finally gets a chance to check his emails. Along with Skype™, email is another important communication tool for Eric.

> ”You do a lot through email. I say email is first [the most used tool] then Skype™ although in the end you Skype™ for long, while email is quick. You are just sending a message, but with collaborators it’s Skype™. Skype™ more, more

[92] La TeX is a document preparation system often used in physics and mathematics documents.

> information is exchanged via Skype™ then via email. So email is more formal, but if you really want to exchange proper information then Skype™ is the way."

At 14.00 we head off to another presentation held in the meeting/common room. This was a slightly more relaxed and a lot less crowded presentation, carried out with PowerPoint instead of on a blackboard. Eric takes his laptop to the presentation, allowing him to check emails throughout.

With the presentation finishing at 14.50, we head back to his office where Eric sends a couple of emails. With no more meetings and presentations planned, Eric is able to spend the rest of his day at his desk working on his laptop, only leaving to borrow a book from a neighbouring theorist.

5.8.2 Summary

With my day with Eric over, there were a number of topics I wanted to explore with him further, particularly around his communication and scholarly practices. However, Keyton's (2005) levels of organisation, Fahy and Nisbet's (2011) typology of science media professionals and Borchelt and Neilson's (2014) functions of scientific public relations were not applicable to this case.

After witnessing how Eric and his colleagues worked through their paper, it was clear analogue technologies were still surviving in the digital age. While early studies pointed to the unique elements of digital technologies, such as PowerPoint, to benefit academia by promoting attention through use of colour, graphics, pre-organised presentations and variation of text size and fonts (Lowry, 1999; Harknett and Cobane, 1997), Murray (2015) describes how such technologies have instead been blended with traditional methods and analogue technologies. This blending has resulted in muddled ecosystems of practices (Grand *et al*., in press), with the blending of traditional practices with digital practices. One particular example is the continued use of the blackboard by Eric and his colleagues, alongside a laptop. During the observation, the blackboard was seen to be used as a traditional teaching tool during presentations, and as a collaborative tool while brainstorming and exploring ideas in the office.

To understand why technologies are adopted and integrated into working practices or not, numerous factors need to be taken into account. As Koehler and Mishra (2009) describe, the affordances and constraints of specific technologies influence the way they are used, but this relationship is not straightforward. Adoption of technologies are also influenced by social and cultural factors specific to the research community (Hara *et al*., 2003). As Eric explains, the blackboard allows the quick sharing of information between colleagues, allowing equations, diagrams etc. to be written down and erased again quickly. During the presentations, the blackboard slows everything down, forcing the presenter to go through the process, making their thinking visible and open to critique. Eric has not been able to find a digital equivalent that allows for the same level of collaboration and effective communication of ideas.

The observations also provided an insight into the various scholarly practices present within theoretical physics in the digital age using Palmer *et al's.* (2009) scholarly primitives (outlined in Chapter 2, Section 2.4.1). While only representative of a single observation day, the scholarly primitives of *Scanning, Assembling, Co-authoring*, *Coordinating*, *Disseminating*, *Consulting, Networkin*g, *Monitoring, Note taking* and *Data Sharing* were all observed in Eric and other Theoretical Physicists. These functions were fulfilled with both analogue and digital technologies. The collaborative activities of *Coordinating*, *Consulting* and *Networkin*g, for example, were achieved primarily through face-to-face meetings and presentations, yet Eric explains how digital technologies have allowed some form of collaboration and information exchange with colleagues, especially those at other institutions. As Walsh *et al.* (2000) describe, email is a well-established tool for communicating and sharing information with collaborators, while increasingly social technologies are allowing for more engaging and interactive collaboration between groups. This was apparent with Eric's use of Skype™, which as he described, has allowed him to communicate and share information across distances. For Eric, Skype™ is better suited for complex exchanges of information compared with other technologies, such as email.

I was also particularly interested to find out about Eric's relationship with other groups at CERN. From observing the meetings between experimentalists and theoretical physicists, there was a clear tension amongst and between the two groups. It could be argued that part of this is down to the institutional imperative of Organised Skepticism

(Merton, 1942/1973) that exists within these groups. As described in Chapter 2, Section 2.2, there’s a desire to keep experimental data within collaborations until they have been confirmed, a process that can cause tension with other groups who may be interested in the data. As Eric describes, a certain level of distrust and closed, internal communication can be useful, encouraging checking and cross-checking of results, but this is a fine balance, with too much distrust becoming counter-productive.

5.9 Conclusion

This chapter documents the eight observations carried out as part of this thesis. Each analyses’ was developed by combining relevant quotes from interview data with the observational data, adding depth and breadth to the analyse, with quotes providing the participant’s interpretations of the activities witnessed, while also helping to place the interviews in the context of the observations.

These case studies were designed to provide an insight into Sub-Questions 4-13 (Chapter 2, Section 2.6); through the tracing of the various communication activities of the Communications Group and the role they play in disseminating scientific information. Aspects of Sub-Questions 1-3 were also identified throughout the observations, especially surrounding how the organisation of CERN, and in particular the organisation of the Communications Group, effected communication practices and openness. Using Keyton’s (2005) levels of organisational culture, numerous issues were seen at Keyton’s process level across the six members of the Communications Group, where the physical separation between the members was inhibiting effective communication across the group, with the primary channels of weekly meetings and daily ‘puzzle zone’ practices (Munkejord, 2007) seeming inadequate for the effective sharing of information. This in-turn effects Keyton’s (2005) subjective level, the inter-relationships between the members of the group, including levels of cooperation, trust and value in the roles of others and levels of openness. While the observations provided a useful insight into these aspects of organisation at CERN, Sub-Questions 1-6 are followed up in more detail through the interview analysis, outlined in Chapter 7, where Keyton’s (2005) satisfaction level and the integration of internal and external communication across the organisation is explored.

In terms of the function of the Communications Group, the individual role of each member was explored through the observations, using Fahy and Nisbet’s (2011) typology of media professionals. Many of Fahy and Nisbet’s (2011) typologies were seen within the activities of the members, especially ‘The Conduit’ and ‘Curator’ roles, as well as ‘The Agenda-Setter’ and ‘Convenor’. The most common, however, across the participants appeared to be that of the ‘Advocate’, demonstrating the public relations function that underlies many of the members. As Borchelt and Neilson (2014) describe, public relations is coming to play an increasingly prominent role within science communication. With many individual, *Programme* level public relations functions identified through these case-studies, the cross-case analysis in the following Chapter helps to identify the role of the whole Communications Group in the dissemination and mediation of scientific information, and how the group achieves at Borchelt and Neilson's (2014) high order *Organisational* and *Societal* levels of public relations.

The tracing of the participant's use of technology throughout the observations provide an insight into Sub-Questions 7-9, exploring how digital technologies have impacted on working and communication practices of CERN researchers and media professionals. The main analogue and digital communication channels used across the case studies were face-to-face, email, the telephone, social media, Skype™ and Instant Messaging. It was clear through the observations that the adoption of technology was influenced by numerous factors such as those outlined by Mark and Poltrock (2004), including the culture, organisational context, the individual's role, the individual's needs and the specific task. It was also clear that the features of specific technologies also had an impact on how and when they were used. As Peters (2006) describes, these features focus around the ability to control who the information is shared with (Control of Contact), and the amount of information that can be shared and how it can be interacted with (Control of Content). Within organisations, Peters (2006) describes how emails support groups whose members are dispersed, such as the Communications Group. As such, emails were the preferred communications method for many of the participants, including the Internal Communications Manager who is able to assign priority to each message and control the contact she has with others.

The degrees to which technologies were incorporated into working practices of the participants also varied across the cases. While technology had been well-incorporated into working practices of the Head of Press, who used social media extensively within his role, others, such as the UK Communications and Innovations Officer, still preferred analogue over digital technologies when it came to working practices. Munkejord (2007) also outlines how the combining of tools and technologies will be influenced by task complexity, contextual or situational constraints and the tools that are available, as well as identity (Grand *et al*., in press). In many cases, digital technologies were used in conjunction with analogue technologies. This was particularly striking with the theoretical physicist and his colleagues, using the blackboard while gathered around the laptop. The result is a muddled ecosystem of digital and analogue tools and practices. While communities can benefit from such mixed ecosystems (Grand *et al.*, in press), through the mixing of skills and competencies, this can cause challenges when individuals work across communities, as seen with the experimental physicist.

Technology was also important when it came to openness in many of the cases. The use of Google Hangouts™ by the Social Media Manager to engage and interact with audiences provided a certain level of openness, while the Head of Press was careful in his use of digital technology when discussing potentially sensitive issues with journalists. Issues over openness were also seen with the handling of the embargoed Press Release and the release of information surrounding the potential new collider. Across both of these examples is the issue of timing of openness. Regarding the study into the new collider, the Head of Press realised the importance of the early, upstream release of information. This is contrasted by the use of embargos, as outlined in the Social Media Managers case, which restricts the release of information and, as Kiernan (2003) argues, facilitates news processing over news reporting, with the select number of journalists able to set the news agenda having further implications for openness. Yet both of these practices can be used as instrumental, strategic, public relations functions, designed to influence actors within Miller *et al's.* (1998) Circuit of Mass Communication for a particular purpose.

Across the case studies, there were a number of methodological issues that emerged during the observations. One issue was the language barrier during the observations with the Social Media Manager, Web Manager and the Head of Press, where numerous interactions with colleagues were carried out in French. As Temple (2002) describes, when a language barrier exists between qualitative researchers and their participants, there are unique challenges that need to be overcome. Data can be ignored or missed completely if the researcher cannot understand what is being said. Such challenges can be overcome through the use of interpreters or translator services (Squires, 2008), yet how such services are used can affect the results of the research (Temple, 2002) and the 'trustworthiness' of the data. Methodological triangulation, as applied in this study, can also help minimise such effects on the validity of the data (for a discussion on triangulation, see Chapter 3, Section 3.1.1). Where issues over language did occur, participants were asked to clarify these moments during the interviews in their own words, minimising any subjective interpretation on the part of the researcher. Furthermore, the ability to observe participants practices, such as the use of technology, was unimpeded by any language barriers.

A further issue surrounding access was also experienced. During the observation day with the Head of Communications, I was asked to leave during one of his meetings with a member of the Human Resources Department when dealing with a confidential issue. As Hammersley (2007) describes, issues over access are ever present within ethnographic research, both at initial negotiating stages and during the actual observation period. Issues over access can be in relation to access to individuals/groups or to specific settings. This again causes issues over data being missed. Such issues can again be addressed through methodological triangulation, as described above. In contrast, access was also increased at times when switching between observer as participant and participant observer. This switch brought me closer to the participants, their practices and the products of their communications.

Despite a few methodological issues, these observations provided a unique insight into the communication and working practices of the participants. The focused, individual analysis of each case study in this chapter allowed me to familiarise myself with the data. As Eisenhardt (1989) describes, this allows the unique patterns of each case to emerge before seeking patterns across the case studies, with familiarity accelerating the cross-case comparison. The following Chapter examines findings across the studies through a cross-case analysis. Such cross-case analysis goes beyond the initial impressions of the individual cases, applying theoretical lenses to bring the data closer to the theory.

Chapter 6 Cross-Case Discussion: Public Relations and the Impact of Digital Technologies on Working and Communication Practices

While Chapter 5 explored each of the eight case studies individually, this chapter is the first of two to provide a comparative analysis, examining the cases through the lenses of digital scholarship, scientific public relations and science mediation (outlined in Chapter 2, Sections 2.3-2.5). This cross-case analysis provides an additional layer of analysis, further exploring the findings of the case studies. Such cross-case analysis can help the generalisability of the data, far more than an individual analysis (Eisenhardt, 1989), as well as strengthen the rigour and trustworthiness of interpretations of the data (Denzin, 1997).

This chapter starts with an explanation of the findings related to Sub-Questions 9-13 (Chapter 2, Section 2.6), focused around the role of the Communications Group in the mediation of scientific information. The observations carried out have identified a number of scientific public relations functions that the various members of the Communications Group undertake in fulfilling this role. The role of public relations within scientific organisations is described, providing specific examples from across the case studies that outline how the group carries out these functions. This is followed by Section 6.2, where the impact of technology on the communication and working practices of CERN researchers and media professionals is discussed, providing insights into Sub-Questions 7-8. While this chapter examines the case studies through the lenses of digital scholarship (Weller, 2011), scientific public relations (Borchelt and Nielson,

2014) and science mediation (Miller *et al.,* 1998), Chapter 7 explores organisational (Keyton, 2005) and openness in a focused, systematic, cross-case analysis of the document and interview data.

6.1 Where does the CERN Communications Group Sit within the Process of Mediation of Scientific Information?

This research sought to identify the role of the CERN Communications Group in the process of mediation of scientific information (Miller, 1999) and their position within Miller *et al.* (1998) Circuit of Mass Communication (discussed in Chapter 2, Section 2.5). While the Circuit of Mass Communication was developed in the early days of the mainstreaming of digital technologies, this research has also sought to revisit the circuit within the context of the digital age.

To achieve this, two main analytical frameworks were used to explore the various roles of the Communications Group, Fahy and Nisbet's (2011) typology of science media professionals (Chapter 2, Section 2.4.5) and Borchelt and Neilson (2014) functions of public relations within the sciences. Throughout the case studies, various journalistic practices associated with Fahy and Nisbet's (2011) typologies were observed in four of the cases (these are summarised in Table 6.1). Fahy and Nisbet's (2011) 'Conduit' typology was the most apparent function across these participants, an observed role of the Social Media Manager (Chapter 5, Section 5.1), the UK Communications and Innovations Officer (Chapter 5, Section 5.2) and Internal Communications Manager

(Chapter 5, Section 5.3) and the Head of Press (Chapter 5, Section 5.4). Other types were also witnessed within individual cases, including the ‘Convenor’ role of the Social Media Manager, who uses social media to facilitate direct interaction between physicists and publics. The ‘Agenda-Setter’ role was also apparent within the Head of Press case, who uses Press Releases and contacts with external journalists to draw attention to important issues that are then picked up by other media outlets. Yet, it appears these journalistic functions are primarily underpinned by their roles as ‘Advocates’, aiming to promote the work of CERN rather than provide unbiased reporting.

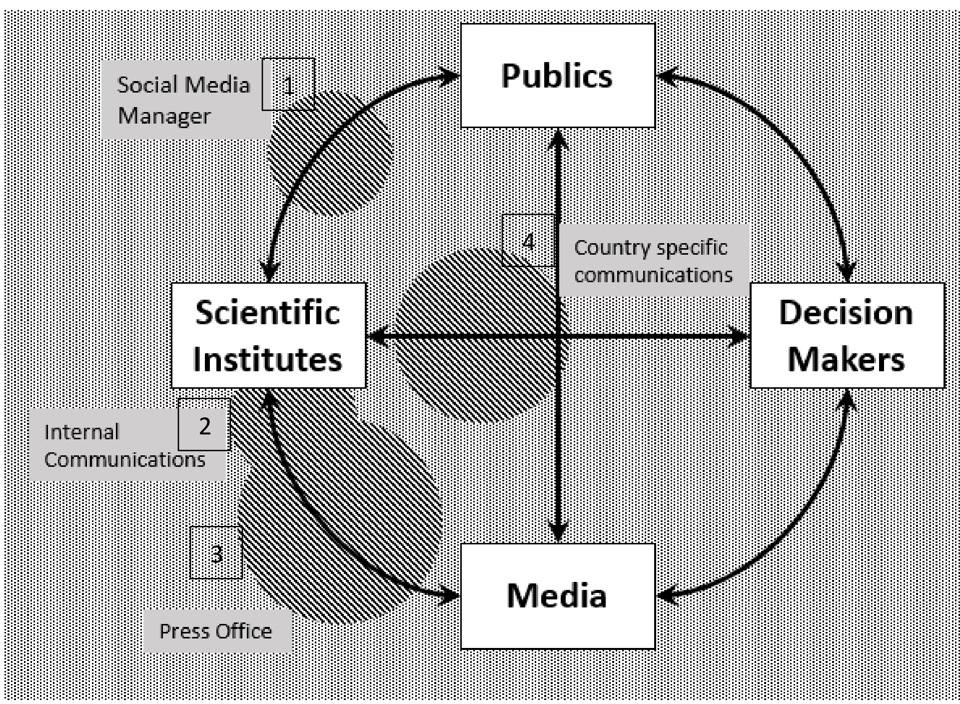
These scientific public relations functions were readily identified as a primary aspect of many of the member’s roles, including the Head of Communications, UK Communications and Innovations Officer, Head of Press, Social Media Officer and Internal Communications Manager. Within these cases, the participants were observed building and maintaining relationships with various audiences, a fundamental part of scientific public relations. Through exploring these scientific public relations function, the role of the Communications Group in the process of scientific mediation in the digital age has been identified. I argue this scientific public relations function intent on achieving positive coverage for CERN, along with the journalistic practices identified through Fahy and Nisbet’s (2011) typology, is integral to the process of mediation.

Table 6.1: Fahy and Nisbet's (2011) typology of science media professionals mapped onto the roles of the Communications Group

	Fahy's (2011) typology of science media professionals								
	Conduit	**Public Intellectual**	**Agenda Setter**	**Watchdog**	**Investigative Reporter**	**Civic Educator**	**Curator**	**Convenor**	**Advocate**
Social Media Manager	•Breaks down scientific information into easily accessible forms and disseminates through social media to various publics.							•Brings together scientists and non-specialist audiences digitally through social media.	•Looks for positive sentiment towards CERN.
UK Communications and Innovations Officer	•Breaks down scientific information from CERN researchers for decision makers.						•Complies news and information within her fortnightly newsletter, UK News from CERN.		•Focus is solely on UK news from CERN. ••Aims to make CERN look as good as possible.
Head of Internal Communications	•Breaks down complex information for non-specialist audience (a specific CERN audience)						•Gathers and compiles news for *The CERN Bulletin*		•Focus on CERN
Head of Press	•Breaks down scientific information for media professionals through Press Releases.		•Identifies areas of research that get picked up by other news outlets (through Press Releases). ••Influences the science news agenda through interactions with media professionals.						•Broader media relations function of the Press Team.

Figure 6.1 represents the areas in Miller *et al's.* (1998) 'Circuit of Mass Communication' that the Communications Group operates. The size of the shaded areas demonstrates the main focus of the Group. Within the pilot study (Chapter 4, Section 4.1.2), the media (journalists) were found to be the primary focus of the group, with a lot of effort going into the running of the Press Office (3 in Figure 6.1). However, other sub-sections of the Communications Group are responsible for specific interactions with the other actors in the circuit. These are explored further in the following sections.

Figure 6.1: The areas the CERN Communications Group operate in the 'Circuit of Mass Communication' (Miller et al., 1998).



6.1.1 Scientific Public Relation at CERN

As Borchelt and Neilson (2014) describe, scientific public relations plays an increasingly prominent role in science communication, with scientific organisations using public relations activities to develop relationships with a range of stakeholders, end-users and publics (as identified in CERN, 2011), in order to gain and maintain support for the work of the organisation. For Borchelt and Neilson (2014), scientific public relations involves managing the 'trust portfolio', the range of strategic communications programmes that build, maintain and sometimes repair these relationships. The form these strategic communications take depends on the goals of the organisation, what the researchers, information officers and communication managers want to do with their knowledge and how they want to be perceived. Table 6.2 maps CERN's various stakeholders (as outlined in Chapter 4, Section 4.2) onto the actors in Miller *et al's.* (1998) Circuit of Mass Communication.

Table 6.2: Mapping of CERN's various stakeholders (CERN, 2011) onto Miller et al's. (1998) Circuit of Mass Communication.

Scientific Institutes	**Media**	**Publics**	**Decision Makers**
High-Energy Physics Community	International Media Professionals	The general public	Potential Sponsors
Alumni	National journalists	The Local Community	Member States
The CERN Community	Local journalists	Educational Systems	Scientific institutions
		Younger Children	Politicians and civil servants
		Industry and Job Seekers	Research council funders

As Borchelt and Neilson (2014) outline, there are four levels of organisational management that contribute to effective scientific public relations within an institute. These are the *Programme, Functional, Organisational and Societal* levels. The *Programme* level looks at the components of the various scientific public relations programmes the organisation produces, exploring if they are suited to the goals/objective of the programme. Through the individual case study analysis in Chapter 5, numerous examples of focused scientific public relations programmes used by the group to engage with these publics and stakeholders and to achieve strategic goals were observed. The observations have provided a useful insight into how scientific public relations practices are enacted within a 'big' scientific organisation, an area lacking in research. Many of these examples also demonstrate how digital technologies can be utilised to fulfil these practices (explored in Section 6.2).

This cross-case analysis takes this further, looking at the suitability of these programme components, as well as at Borchelt and Neilson's (2014) higher order *Functional*, *Organisational* and *Societal* elements, using the position of the Communications Group within the updated Circuit of Mass Communication (Miller *et al*., 1998) providing the new analytical focus, examining how they interact with the other actors in the circuit.

6.1.2 Publics

As shown in Table 6.2, many of the Communications Groups identified stakeholders make up this actor in the circuit, including the local community, the general public, educational systems, cultural and artistic community, younger children, industry and job seekers (CERN, 2011). During the observations, numerous *Programme* level activities aimed at these stakeholders were witnessed, specifically with the local community, the general public and educational systems.

The local community, residents in Geneva, Vaud and neighbouring France, are a key stakeholder group that the Communications Group attempts to reach in order to develop trust and advocacy with the group, promoting the benefits CERN brings to the area. Maintaining and developing trust with the local community is fundamental to CERN's progression as a research institution. This is exemplified in the Head of Press Case study and the creation of a Press Release about the potential new collider. The Head of Press had been encouraged by the person in charge of Local Communications to put out a Press Release. Along with this, local authorities were contacted before the Press Release was sent out, informing/reassuring them about what is coming out. A local journalist was also brought in to make sure an article was present in local newspapers.

I argue the group's decision to inform the Local Community of this intended technological development at CERN is an example of what Wilsdon & Willis (2004) calls 'upstream engagement', where discussions around complex scientific issues are initiated with publics in the early stages. As Irwin (2009) describes, such engagement can be used to empower, restore or maintain levels of democratic engagement among publics with various areas of scientific and 'techno-scientific' endeavour. As Wilsdon & Willis (2004) explain, the reasons for initiating such engagement can be placed in three categories, *Normative*, *Instrumental* and *Substantive* motivations. Those with *Normative* motivations believe such engagement is key to effective democracy, while *Instrumental* motivations have specific interests or intentions. *Substantive* on the other hand aim to improve the decision-making process, allowing publics and stakeholders to put across their views. Such engagement can be used to build trust, manage reputations and improve the social outcomes of technological developments.

The decision behind the group putting out the Press Release and contacting local authorities seems to be primarily *Instrumental*, with the group wanting to inform these stakeholders about what was coming up in order to avoid a negative reaction in the future, maintaining their trust and relationship and avoiding future needs to repair these relationships. There are no clear *Substantive* motivations, as it doesn't appear they were looking for input from local stakeholders at this point in time (although this may be planned downstream), rather just to inform about what could occur.

Another valued communication tool for communicating and engaging with the various publics identified by the Communications Group is social media. The observations with Social Media Manager provided an insight into how the group reaches members of the general public, and in this particular case, educational systems, with the Google Hangouts™ witnessed tailored for American High School students. The group's strategic goals for engaging with such educational systems is to develop knowledge of CERN's research and physics as well as develop an understanding of the benefits of research to society and promote physics and science as a career choice (CERN, 2011). The use of Google Hangouts™ facilitated a connection between CERN researchers and the High School, allowing direct but distanced engagement between the two. Looking again at Wilsdon and Willis' (2004) motivations for engagement, the use of social media in this case is primarily *Instrumental,* enabling the Communications Group to achieve their strategic goals of developing knowledge of CERN's research with the High School students. Broader *Normative and Substantive* motivations are also apparent, as dialogue between the students and researchers is encouraged, allowing the impacts of CERN's research on biological and medical fields and wider society to be discussed.

Exploring these public relation components in this way allows for a deeper understanding of how these achieve at Borchelt and Neilson's (2014) levels of scientific public relations. Both approaches used by the Head of Press and Social Media Manager enable them to achieve well at Borchelt and Neilson's (2014) *Programme* level. For the Head of Press, the use of Press Releases and his collaboration with a local journalists means the article is likely to be picked up by the programmes intended audience, the local community. With the Social Media Manager, the use of Google Hangouts™ is well suited to her aim of engaging directly with this educational audience and general public and raise awareness of the work done at CERN. At the *Functional* level, both approaches are key to managing the groups 'trust portfolio' (Borchelt and Neilson's, 2014), maintaining trust and positive relationships with two of their key stakeholders under the broader Publics umbrella. Maintaining positive relationships with these stakeholders also helps at the *Organisational* level, making sure support in CERN continues. Finally, these approaches help the group achieve at the *Societal* level through 'upstream engagement', especially where these programmes have some *Substantive* (Wilsdon & Willis, 2004) motivations behind them.

6.1.3 Media

The example of the Head of Press and both his direct and indirect interaction with journalists and other media professionals demonstrates another important relationship the Communications Group need to foster, one with the Media. As a group, the Media can raise awareness of the work of an organisation, potentially influencing other stakeholders. Fostering a strong relationship with media professionals provides the Communications Group with a channel through which they can reach other stakeholders, with positive coverage helping to improve how the organisation is seen by these stakeholders. Kallfass (2009) found a great deal of scientific public relations practitioner's time is spent cultivating contacts in the media, including providing press releases and background material to journalists. In this respect, the 'public' in public relations doesn't do justice to the breadth of actors involved in the process of mediation of scientific information. Hence, within this study, the Circuit of Mass Communication

(Miller *et al*., 1998), helped provide a more useful framework for exploring this diversity within ‘public’ relations.

As described in the pilot study (Chapter 4, Section 4.2), the CERN Communications Group spend a lot of their time during their steady state building these relationships with Media and individual journalists through such practices. This was revisited during the latest interviews, with the Head of Communications explaining how they have maintained interest and built relationships with journalists and media professionals in member states during the long shut down.

> “We wanted to bring the most important commentators from our Member States, influencers from these countries here, take them underground [to the LHC]. We organised every two weeks a slot where they could visit, they could meet people from their own countries. That has generated stories, even though that’s not what it’s all about. The whole point is to familiarise them with what’s here. People have moved on and changed, people have come in since the last time we did it. Most of the time they are journalists and they find stories and go home and tell them. So that has helped.”
>
> (Head of Communications, interview 04.02.14)

With such an approach requiring significant investment in people and resources, this demonstrates the value the Communications Group place on these relationships. While not guaranteeing stories will be generated from such events, the Group are thinking strategically about the long term benefits such relationships can bring. The Pilot Study observations at the EPPCN/IPPOG and InterActions (Chapter 4, Section 4.2.2) meetings also outlined the effort the Communications Group puts into establishing relationships with communications offices in scientific organisations and funding agencies in CERN Member States. As described, the Communications Group sent their Press Release to these various institutions, allowing them to rework and redistribute it, helping to extend coverage within their countries.

The benefit of such long term, relationship building strategies were clear in the Head of Press case, where Gerard was able to use his established relationship with a local journalist to get an article placed in a local newspaper. The journalist also benefits from the relationship, receiving (sometimes exclusive) information early and directly from a reliable source in the Communications Group. Being the first journalist to write about the issue, something that may well be picked up by other media professionals. Such practices have been outlined by Bourdieu (2005) and Fenton (2010), where the pressures of 24/7 news often requires journalists to repackage stories from other outlets. As Allan (2004) describes, there is less reliance on traditional newsgathering techniques and more focus on news collection and processing, with a greater reliance on contacts and information subsidies (Trench, 2008). Gerard is keenly aware of such practices, knowing other journalist may well replicate the message the group has put together across other media. This again demonstrates the ever increasing role public relations is coming to play in the shaping of science news agenda.

With such relationships between Communications Groups and journalists, trust plays a big part. As Blöbaum (2014) explains, trust plays an important role in the various relationships between journalists and the individuals and organisations outside of journalism. In the Head of Press case, Gerard has to trust that the journalists will put together a well-balanced article and synchronise with the groups releasing of data. If they do not, they could be 'black listed' from the groups preferred contacts. To create and maintain such relationships, Gerard utilises both analogue and digital channels (explored in Section 6.2). Yet, as Moloney *et al.* (2013) describe, such relationships raise questions over the balance and objectivity of journalistic reporting. Moloney *et al.* (2013) argue that the growth of public relations industry, and new demands are placed on journalists in the digital age, threatens the quality and independence of journalism, with public relations material being published without independent sourcing. As such, the issue is one of political economy, with the CERN Communications Group providing a cheap and accessible source of information to newsrooms.

6.1.4 Decision Makers

One set of fundamental stakeholders for government-funded research institutions are the Decision Makers. For such institutions, appropriate public relations can help attract potential funders and convince current funders that the money being spent is worthwhile and the research is worth supporting. Within the Communications Group, this is an explicit part the UK Communications and Innovations Officer role. As described in the case study 5.2, Susan is employed by STFC, who coordinate and manage the UK's involvement in CERN. The main activity Susan undertakes as part of her role is to produce the fortnightly newsletter, UK News from CERN. As she describes, the primary audiences for this newsletter is the UK Science Minister and key advisors within government and at STFC. The newsletter itself is focused on the UK's impact at CERN and CERN's impact on the UK, outlining such things as the research UK scientists are undertaking at CERN and the benefit to UK companies and universities. The primary aim of this newsletter is clear; to raise awareness of the return the UK gets for its financial investment in CERN.

When discussing her newsletter, despite it fitting well within Fahy and Nisbet's (2011) 'Conduit' typology, the UK Communications and Innovations Officer agrees it is more of a public relations rather than a journalistic endeavour, which is reinforced when discussing her working identity. Susan explains it is her intention to represent the UK and the people she talks to in a positive light. With this, Susan finds it important to make sure her articles are factually correct and that she hasn't misrepresented anybody. This was seen during her observation, with Susan checking back with the researchers she interviewed for her article before finalising it.

6.1.5 Scientific Institutes

According to Kallfass (2009), another area of public relations within scientific organisation that is important but often overlooked is internal communications. Such internal communication is a key part of the link between the Communications Group and CERN as a Scientific Institute. As Kallfass (2009) describes, internal communication is also needed to allow for effective communication with other stakeholder audiences. This is again outlined in the CERN 2012-2016 Communications Strategy (CERN, 2011), where the CERN community is a key stakeholder they aim to engage with in order to motivate people to communicate and foster a sense of belonging. Relationships need to be established between CERN researchers and the Communications Group, with appropriate channels open to allow for these groups to connect with each other. This is primarily dealt with by the Internal Communications Manager, but other members of the Group also have an impact on internal relations. Internal communication also requires CERN staff and researchers to provide stories and information on a timely basis.

As described by the Internal Communications Manager Case, the *CERN Bulletin* is a well-established and well-respected channel through which information can be passed to the CERN community. Due to the nature of CERN, despite being an internal communication medium, many copies of *The Bulletin* are distributed outside of the physical location of CERN to affiliated people in universities and laboratories worldwide, as well as retired staff. This is set up by a free subscription. Around 500 printed copies are also distributed around the CERN site every fortnight.

Being well-established at CERN, the community are aware of how to connect with Internal Communications through this channel. As Francesca explained in Chapter 5 Section 5.3, *The Bulletin* is a key internal channel for the CERN community, who are able to send emails to the weekly.bulletin@cern.ch email address, informing her of stories that are coming up and asking if she wants to cover it. This indicates CERN have a strong link between researchers and the Internal Communications Team.

Along with CERN, the Communications Group also has direct interactions with other scientific institutions. As outlined in the Pilot Study (Chapter 4), the observations at the EPPCN/IPPOG and InterActions meetings also demonstrate the effort the Communications Group puts into establishing relationships with communication offices in scientific institutes within CERN member states and beyond.

6.1.6 Summary

This section aimed to outline the position of the CERN Communications Group, and its scientific public relations functions, within Miller *et al's*. (1998) 'Circuit of Mass Communication', reworking this model in the context of CERN and the digital age. I argue that the communication practices identified across its members, paired with the public relations intent of these practices, places primary focus of the Communications Group in an intermediary position between Scientific Institutions and the Media within the circuit (Figure 6.1). In addition, the group facilitates interactions with the other actors in the circuit. In many instances, the Communications Group provides the channels through which these actors can gather information from CERN. However, the importance of the group becomes clearer when exploring their internal role of centralising information from all sectors of the labs and the experiments. As outlined in Chapter 2, Section 2.2, the ‘Adhocracy’ (Mintzberg and McHugh, 1985) and ‘Post-traditional Communitarian’ structure of the experiments (Knorr-Cetina, 1999), along with the nature of the scientific validation process within the experiments, means no one person can know everything there is to know about the experiments, indicating knowledge is widely dispersed across the various experiments. It is partly the task of the Communications Group to collate and repackage this knowledge, so it can be effectively disseminated to CERN’s external actors and stakeholders. As Kallfass (2009) describes, this internal process is an under researched area when it comes to scientific public relations. This study was able to explore parts of this internal process through observations with the Internal Communications Manager and the importance of internal communication channels, such as the *CERN Bulletin*. The impact of this organisation is explored further in Chapter 7.

The establishing of public relations within the Circuit of Mass Communication and the Communications Group position within it provided the analytical focus for this cross-case analysis and the exploration of the groups trust portfolio (Borchelt and Neilson, 2014). Using Borchelt and Neilson’s (2014) levels of public relations, this study has identified a number of individual *Programme* level activities that the group undertakes, aimed at specific stakeholder groups and actors in the Circuit of Mass Communication (Miller *et al*., 1998). This includes Decision Makers through such activities as the UK Communications and Innovations Officer’s fortnightly newsletter sent directly to UK Science Minister and key advisors within the UK Government, Media through the Head of Press and the relationships they build with journalists through Press Releases and Media Visits, Publics who are directly engaged through Social Media and Science Institutes through internal communications and interactions with external High Energy laboratories across the world. While further work is needed to establish the effectiveness of these *Programme* level activities, those observed seemed well suited to the actors and stakeholders they were aimed at, indicating success at the *Functional* level, helping to manage and maintain relationships with these groups. Many of these programmes may also directly achieve at the *Organisational* level, with activities such as those of the UK Communications and Innovations Officer helping to maintain support from the UK Government. Finally, at the *Societal* level, many of the Communications Groups programmes are not just aimed at building trust and the reputation of CERN, but in High-Energy Physics more broadly through continued work with physics institutes across the world.

6.2 How Have Digital Technologies Impacted on the Working and Communication Practices of CERN Researchers and Media Professionals?

The functions explored in Section 6.1 have demonstrated the numerous ways in which the CERN Communications Group communicates with various audiences. This section explores how digital technologies have come to influence these functions and other working and communication practices observed across the cases. As Mark and Poltrock (2004) outline, the adoption of communication technologies within organisations can be influenced by a number of factors, including the organisational context, an individual's role, the individual’s needs and the specific task. Furthermore, the features of the technology will also affect its suitability for specific tasks. As Peters (2006) describes, these features focus around the ability to control who the information is shared with (Control of Contact), and the amount of information that can be shared and how it can be interacted with (Control of Content). Munkejord (2007) also outlines how the combining of tools and technologies will be influenced by task complexity, contextual or situational constraints and the tools that are available.

In order to understand how an individual’s use of technology impacts on their communication, working and engagement practices, Grand *et al*. (in press) developed a typology of digitally engaged researcher that broadly categorises users based on their use of technology during these practices. These include the ‘highly-wired’, ‘dabbler’ and the ‘unconvinced’. However, these categories are not designed to represent fixed roles, rather they are ideal types. Individuals can cross categories throughout their career, depending on their role and the specific tasks they are undertaking. Mixes of such individuals with varying digital capabilities will also be found to various degrees within communities. Such variations were seen across the cases, as illustrated in Chapter 5. Using Grand *et al’s*. (in press), the tracing of each participant’s use of technologies for communication and working practices enabled them to be placed within these typologies. This provides an insight into the muddled nature of the digital mediated ecosystem of the Communications Group.

6.2.1 Blended Communications, Blended Identities

Throughout the observations, numerous digital and analogue technologies were used by the various members for communication, working and engagement practices. The main analogue and digital communication channels were face-to-face, email, the telephone, social media and Skype™ (Skype™ also includes its Instant Messaging function that was used in a number of cases). The features of each of these communication channels have been summarised in Table 6.3. This Table has been partially adapted from the work of Peters (2006). The following sections explore the use of analogue and digital technologies by the participants, using this to identify the participant's identity within Grand *et al*'s. (in press) typology of digitally engaged professionals.

6.2.1.1 The Role of Face-to-face Communication: Routine and Spontaneous Meetings

While all manner of technology clearly play an important in information sharing in the digital age, face-to-face communication is still heavily relied upon. Face-to-face was the preferred method of communication when it came to interactions with co-located users, when dealing with sensitive information and when immediacy and responsiveness is paramount. Throughout the case studies, face-to-face communication ranged from formal weekly meetings to informal reactive contact with colleagues, both one-on-one and one-to-many.

In its most formal, the weekly editorial meetings is a routinely established meeting between the numerous[93] people involved in communications activities across CERN. As described throughout the case studies, these meetings are there to allow participants to tell the group the stories they are aware of, what has come in since they last met. In effect, these meetings are where the various activities and pieces of information gained from other communication channels are can be aligned and synchronised across the group.

Yet in practice the meeting I attended appeared difficult to manage, with more than 20 people packed into one room, half of them seated around a table, the other half crammed in around the side. With so many people present, the meeting doesn't lend itself to dialogue between members, instead people take it in turns to tell the group what they are working on, with this meeting overseen by a member if the Web Team who keeps the group focused and on track, making sure what is promised is delivered.

Along with formal meetings, informal face-to-face interaction was another communication channel used across all cases. Such interactions will often have minimal Control of Contact, with whatever item brought to do the door often taking priority over everything else. As Perlow (1999) describes, the spontaneous and opportunistic communication close proximity brings is not always welcome, often becoming

[93] Each of the weekly meetings I observed were attended by over 20 individuals.

interruptive and can reduce productivity if it gets out of hand. This was recognised within the Head of Press case study (Chapter 5, Section 5.4), who has established a closed door policy, which signals he does not want to be disturbed. Yet face-to-face communication allows quick sharing of information when colleagues are nearby.

Table 6.3: A selection of key observed features of the communication channels utilised by the CERN Communications Group and CERN Researchers to collaborate and share information (adapted from Peters, 2006).

	Face-to-Face	**Email**	**Phone**	**Skype™ (Audio/visual)**	**Social Media (Twitter™, Facebook™, Google Hangouts™)**	**Instant Messaging**
Location of Users	Co-located	Dispersed	Dispersed	Co-located or Dispersed	Dispersed	Co-located or Dispersed
Forms of Communication	One-to-one One-to-many Many-to-many	One-to-One One-to-Many	One-to-One One-to-Many (Conference Phone)	One-to-One One-to-Many Many-to-Many	One-to-One One-to-Many	One-to-One
Communication Style	Synchronous	Asynchronous or Near Synchronous[94]	Synchronous	Synchronous	Asynchronous Near Synchronous (with chat functions) Synchronous (with video)	Near Synchronous
Social Cues	High	Medium (with emoji's)	Medium	Medium (voice only) High (with video)	Medium (with emoji's) High (with video)	Medium (with emoji's)

[94] For a discussion on near synchronous computer mediated communication, see Holliman and Scanlon (2006).

As Munkejord (2007) describes, face-to-face is often the preferred communications method when distance is short and/or a tasks needed attention urgently. This was evident with the Head of Communications, who prefers to go and speak to nearby colleagues, while using the phone and email to cover distance.

6.2.1.2 Emails: Near Synchronous or Asynchronous Communication

Within organisations Peters (2006) describes how emails support groups whose members are dispersed, providing one-to-one and one-to-many communications. Email is asynchronous compared to other channels (such as Skype™, the telephone, or face-to-face communication) while allowing individual knowledge to be disseminated to a wider number of people at any one time. Yet, the ease to which information can be distributed to numerous people can prove both useful and intrusive. This issue is best outlined with the Experimental Physicists and the challenge of managing her two roles as physicist and Outreach Coordinator. In this case, Emily finds herself copied in on numerous email exchanges regarding ATLAS outreach, information that is not always relevant to her or that she doesn't know what to do with. As she explains, dealing with emails is difficult for her and she struggles to cope with the amount she receives, with the distribution of emails lacking coordination and targeting.

For Emily, her role and the nature of emails means she is unable to control the information she receives. Being new to the role, Emily is yet to develop an appropriate process to filter through her emails efficiently, unlike some of the other participants in the study. Both The Head of Communications and Web Manager also receive hundreds of emails a day, but both have established a process of filtering emails into separate folders set up on their mailbox. In this respect, features of the technology (such as the ability to create folders) can be used by individuals to mitigate negative effects e.g. information overload. Even so, this still takes time, often requiring the skills associated with the 'Highly-wired' worker (Grand *et al*., in press).

From another perspective, with the Internal Communications Manager having the ability to email the whole CERN community, she is able to distribute important information across CERN quickly and easily, yet is keenly aware of the dangers of sending excessive amounts of mass emails. For the Internal Communications Manager, email is her preferred method of communication, as she is able to assign priority to each message and deal with issues at her own pace. In this respect, she benefits from the asynchronous nature of email communication and the control of contact she can take. For the Internal Communications Manager, the phone does not give her the same level of control of contact. As she describes, receiving a phone call means it immediately takes priority over what task is currently underway. Working in a shared office, the phone can cause a lot of disturbance for her and her team.

Across the case studies, there were further examples of the benefit of email and the control of contact it allows in terms of accessibility to information across time and space. One example is the Head of Communications, who is able to travel with his email and work through them while on the move, without needing to be connected to the internet. He is then able to easily synchronise when back online. As Larson *et al.* (2008) describe, digital communicative technology, such as mobile email, has reduced the isolating effects associated with traveling, allowing connected and 'communicative travel'. Such technology can also afford 'micro-coordination' (Ling, 2004), allowing individuals to organise and manage communications while on the move. Similarly, the UK Communications and Innovations Officer is able to use digital technologies, including emails, Skype™ and Social Media to stay in touch with external colleagues based at STFC.

6.2.1.3 Task-focused Approaches to Communication

What was also clear across the cases was how the nature, complexity and urgency of a task will also influence which technology is used, and if a combination of technologies is required. This was seen in the time spent with the Web Manager, Experimental Physicist, Theoretical Physicist and Social Media Manager. With the Experimental physicist, Emily decides to use the phone over email when she runs into a problem with her presentation. Similar was seen with the Social Media Officer, who instead of replying to an email about a visit to ATLAS decided to phone the person instead. The Theoretical Physicist explains how he uses emails for formal correspondence, but not for longer, more complex exchanges, preferring Skype™ instead. In the case of the Web Manager, Ben had been in an ongoing email correspondence with an external colleague about CERN's top-level domain. With the correspondence becoming more complex, Ben tries to phone his colleague instead of sending another email.

In all these examples, the near synchronous or asynchronous nature of email becomes its limiting factor. As Ben explains, it could take ten back and forth emails or ten seconds over the phone. Such a quote indicates emails can be less suited to complex communications then the phone or other technologies in certain circumstances. The Web Manager examples also provide an interesting demonstration of communication usage patterns. Failing to reach his colleague by phone, Ben returns to email to contact them. This example also demonstrates the way communication channels can work synergistically with each other, rather than in competition. This pragmatic approach to the use of communications tools, rotating between multiple communications technologies, increases the chances of the communication being successful. Ben also uses Skype™ and its instant messaging feature in a similar fashion. Ben can use instant messaging to coordinate further communications without interrupting the recipient i.e. asking if they are free to chat before phoning or initiating a Skype™ call. Similar findings were seen in Nardi *et al.* (2000) where instant messaging was used as a channel to exchange content and coordinate information quickly and effectively.

A further feature of control of content is the longevity of the communication, and issues over confidentiality this can create. As Daw (2001) describes, emails are not as ephemeral as phone and face-to-face conversations can be, with people able to archive messages and conversations. This was most apparent in the Head of Press case study and his interactions with journalists. Here, Gerard is cautious when it comes to writing down potentially sensitive information in emails, preferring the phone instead. While the fact a call has been made may be evident, the content of the call is not as easily traceable. The phone is also Gerard's preferred method for contacting journalists in order to build relationships. Gerard is aware of the difficulty in building relationships through emails. As the likes of Rice (1993) and

DeSanctis and Monge (1998) describe, text only media, such as emails, provide limited social cues compared with face-to-face and even the phone. Such technologies, therefore, are not ideal for building rapport and trust.

As well as building relationships, communication technologies were also important in maintaining relationships, especially with external colleagues. Some research has shown that people can maintain a sense of interconnectedness through communication technologies even in dispersed groups (Katz and Rice, 2002; Wellman and Gulia, 1999). Communication technologies can create a ‘connected presence’ (Licoppe, 2005) where technologies can be used to multiply encounters with friends (or colleagues) who are geographically dispersed. This was seen in many of the case studies. With the UK Communications and Innovations Officer, it is important for her to remain in contact with colleagues at her home institution (STFC). Susan achieves this through not only her STFC email account, but through more informal social channels, especially Facebook™ and Skype™. While Susan uses such technologies to main relationships in informal ways, others use the technology in more formal, collaborative ways. The Internal Communications Manager uses Skype™ and Google+ to hold virtual meetings with distant colleagues, as does the Theoretical Physicist.

6.2.2 Impact on Working Practices

While all participants used digital technologies for working and communication purposes, numerous variations were seen. In many cases, digital technologies were used in conjunction with analogue technologies rather than replacing them. To understand why technologies are adopted and integrated into working practices or not, various factors need to be taken into account. As discussed in Chapter 2, Section 2.4.4 the adoption and use of technology by media professionals is influenced by a number of factors, such as the individuals daily routine (Domingo, 2008), workplace organisation (Majoribanks, 2000), available resources (Ursell, 2001), technical skills/multimedia competences (Deuze, 1999) and the individual needs/desires (Domingo and Castello, 2006).

One particular example of the blending of analogue with digital technologies was seen during the Theoretical Physicist observation and the continued use of the blackboard: chalk and talk. As a tool, the blackboard is typically immobile, yet easily editable and accessible to many. During the observations, the blackboard was used as a traditional research tool during presentations, with one blackboard at the front of the room, the audience facing it and a presenter writing with chalk, erasing and explaining various diagrams and equations. It also functioned in a more collaborative way, being used in conjunction with digital technologies (a laptop) by Eric and his colleagues, brainstorming and exploring ideas in the office. In this instant, the blackboard functions as a collaborative tool, not being controlled by a single person, but used by each member of the group. It becomes the point of discussion and negotiation and where the construction of meaning occurs. The laptop was then used to record the finished idea.

Within this case study, the blackboard fills two functions. During the presentations, the blackboard slows everything down, forcing the presenter to go through the process, making their thinking visible. In contrast, during smaller meetings, Eric explains the blackboard can speed things up, allowing equations, diagrams, etc. to be written down and erased again quickly. What is missing for Eric is a tool that allows him to collaborate in such away at distance; a digital equivalent to the blackboard. While Skype™ has allowed Eric to communicate at distance, he also explains how it doesn’t allow him to collaborate and express ideas in the same way or as efficiently.

In a similar respect, the UK Communications and Innovations Officer continues to use longhand notes with paper and pen when carrying out interviews, instead of using an audio recorder or another form of digital recorder. This, as Susan describes, comes down in part to personal preference, and the time it would take to learn how to use a new technology (reskilling). Delamont (2012) explains how audio recorders can be less intrusive compared with pen and paper, where the interviewee can see when notes are being taken. Susan does however use technology to construct her articles, sourcing images and referring to other articles.

What’s clear in these examples is digital technologies have not come to replace analogue technologies in all instances. While early studies pointed to the unique elements of digital technologies, such as PowerPoint, that could benefit academia by promoting attention through use of colour, graphics, pre-organised presentations and variation of text size and fonts (Lowry, 1999; Harknett and Cobane, 1997), Murray (2015) describes how such technologies have instead been blended with traditional methods and analogue technologies.

6.2.3 CERN Communications and Scholarly Practices: A Muddled Ecosystem

The use of multiple analogue and digital technologies for working and communication outlined above demonstrates the muddled culture of practices in existence within the CERN Communications Group, with the findings from the Experimental and Theoretical Physicists case studies also appearing to be consistent with Grand *et al.* (in press). Within the Communications Group, this mixture of practices has created a muddled ecosystem, with individuals working in distinctly separate ways. As Grand *et al*. (in press) describes, such ecosystems can allow individuals to feed off each other and help develop cultures that appreciate the value of differences in digital capability and use. However, problems can also occur when individual practices conflict with that of others within a community. As Adams (2013) describes, such clashes can cause cognitive dissonance where individuals have to choose between what they want to do and what they feel they should do based on the pressures of others. This appears to be at least partially the case within the Communications Group.

Across the cases, variations in attitudes towards working hours and practices were seen. At one end of the spectrum, the Internal Communications Manager utilised communications technologies to work more flexibly, outside of contracted office hours. In this way the Internal Communications Manager fits well within the 'highly-wired' category. Yet such attitudes and practices are not shared completely across the group. During her interview, the Social Media Manager described how she has been actively encouraging colleagues to separate work and home life, cutting down on out of hours emailing.

IV: “You were saying earlier that you were trying to keep work life away from home life.”

SMM: “Yeah, that’s certainly the aim and that’s something I want to try and encourage my colleagues to do. […] If there’s a particular event perhaps or a big story then you will have emails circulating in the evening, so you will get into work the next morning and there will be 10 emails already in your inbox from colleagues. But that is becoming less and less frequent I would say. I think the culture is shifting I hope. It seems to be moving in the right direction. [..] People seem to be emailing in more normal hours.”

(Social Media Manager, interview 22.01.14)

A similar attitude was found with the UK Communications and Innovations Officer, who described how she resists working at home or at weekends.

UCIO: “I do not work at weekends or at the evenings. No no no no no.”

IV: “So after I left you here [at CERN] you didn’t do any work at home?”

UCIO: “No. The only time I would ever take work home is if I am on a designated working from home day. […] I have been known to check my work email in the evening, but I don’t tend to respond.”

(UK Communications and Innovations Officer, interview 24.01.14)

These conflicting attitudes to working life seems to have caused the Internal Communications Manager to change her working practices to some degree.

IV: Do you check emails at night, over the weekends?

ICM: Yes, always.

IV: Would you send any?

ICM: “I prepare emails, but I only send them, I try and send them only on weekdays, so that people are not annoyed. But I prepare the emails, so Monday I can just push send.”

(Internal Communications Manager, interview 28.01.14)

The attitude of the Internal Communications Manager seems, in part at least, down to her previous role as a physicist. As seen with the Experimental and Theoretical Physicists, the nature of the discipline and the scientific work they carry out means they tend to work long hours, with experimental machines running over the weekends. Such attitudes towards work may have transferred into her current communications role.

The muddling of cultures within CERN, especially in terms of working hours and use of technology, could lead to a number of issues in terms of communication, something the Head of Communications appeared to be aware of.

“The challenge you have here is, as you’ve seen, these are driven people [the physics community]. […] You can’t expect all the support activities to have people who are so driven. They are all very dedicated and motivated people, but they all have a very different opinion to what a work-life balance is compared to a really hard on physicist. […] It doesn’t happen very often, but if there is a crisis over the weekend,

> the machines are running over the weekends, so something could go wrong and you have to put up a crisis management team. […]"
>
> (Head of Communications, interview 04.02.14)

With the physics community working consistently while the machines are running, events that occur in the evenings or over the weekend may either be missed/not communicated in a timely manner or may get out of hand. Added to this the ease of DIY communication as part of digital scholarly practices, there are real risks to the reputation of the organisation, a central issue for strategic communications. Finding a balance then within this muddled ecosystem is a difficult task, something that may be impossible within an 'Adhocracy' (Mintzberg and McHugh, 1985). Furthermore, the physics community is a transient, ever-changing population, making it difficult to achieve consistency. With openness valued across the experiments and the organisation, the danger would be for CERN and the Communications Group to implement strategies or guidelines that 'control' or limited the communication practices of researchers to within a certain window. In a similar respects, as the Web Manager notes (Chapter 5, Section 5.6), the development of web policies need to take similar notions into account, avoiding a too drastic move from a DIY approach to a command and control organisation. As such, the Communications Group should look to develop frameworks and guidelines that supports the collaborations and individual researchers identify their audiences and use various technologies to communicate and engage in increasingly meaningful ways.

6.3 Conclusion

This Chapter outlined the findings from the cross-case analysis, examining the features of each case study in relation the theoretical frameworks that underpin this thesis. As such, the use of multiple frameworks allowed the sociological imagination (Mills, 1959) to reach a deeper analysis of the functions of the CERN Communications Group and the role they play in the mediation of scientific information.

Within this thesis, Miller *et al's.* (1998) Circuit of Mass Communication provided a conceptual model through which this process could be explored. However, this model didn't take into account the function of public relations, such as those identified within the CERN Communications Group, within the process. While physically located within scientific institutes and carrying out many communication practices associated with media professionals, it appears the primary function of the Communications Group is within an intermediary position between these two actors in the circuit. However, the practices identified through the observations demonstrates the broader function of the Communications Group, interacting with and influencing all the actors in the circuit. Yet, the actors defined within the Circuit of Mass Communication don't fully represent the diverse audiences the Communications Group has identified and are actively working with. This is particularly apparent when looking at the 'Publics' actor in Miller *et al's.* (1998) Circuit of Mass Communication and the number of CERN stakeholders that form a sub-section of it. For Michael (2009), 'the public' is not a singular concept; instead made up of dynamic and relational groups. As Michael (2009) argues, such definitions of the public as a 'undifferentiated whole' makes analysis of such a group difficult, in part due to over characterisations placed upon them. As such, Holliman *et al.* (2015) argue that rhetorical conceptualisation of publics should shift from 'public-in-general' to 'publics-in-particular' (Michael, 2009).

This research carried out with the CERN Communications Group illustrates how using such 'publics-in-particular' definitions has helped the group identify specific, well-defined, diverse audiences (See Table 6.2). As demonstrated throughout the case studies, with such definitions, the Communications Group has been able to utilise appropriate technologies (such as Google Hangouts™) and methodologies to reach these smaller, clearly defined audiences. This illustrates the broad nature of scientific public relations at CERN that makes the Communications Group more than a Media Relations Team.

Along with the identification of the public relations functions of the CERN Communications, this study also set out to explore how digital technologies have come to impact on the working and communication practices of CERN researchers and media professionals. With the observations and interviews providing an insight into technology use, Grand et al's. (in press) typology of digital engaged users was used to identify and categorise participants. What became apparent across the case studies was the muddled culture of analogue and digital practices that exists across the participants. Within the Communications Group especially, there was a mix of 'highly-wired', 'dabbler' and 'unconvinced' types, with participants often seen fulfilling multiple types throughout the observations. This was perhaps best illustrated with the UK Communications and Innovations Officer, who can be seen as 'highly-wired' when using digital technologies to stay in contact with colleagues, yet ‘unconvinced’ when it comes to her continued use of pen and paper within her working practices.

Chapter 7 Organisation, Communications and Openness

While the previous chapter primarily focused on the ethnographic observations and the role of the Communications Group and public relations in the digitally-mediated Circuit of Mass Communication (Miller *et al*., 1998), this chapter explores the data to study ideas around organisation and openness. These central concepts have been primarily explored through the document analysis and interviews. All interviews were semi-structured, with some pre-planned questions coming from the observations and document analysis (Appendix D), while still allowing for flexibility and participants to respond in their own words (the interview approach is outlined in Chapter 3, Section 3.4).

Combining analysis of these data streams, issues of organisation effecting communications and openness have been explored within Keyton's (2005) levels of organisational culture. These levels were explored across CERN as a whole and within the Communications Group.

7.1 Organisation of CERN

As outlined in the literature review (Chapter 2, Section 2.2), the nature of the experiments with their 'Adhocracy' (Mintzberg and McHugh, 1985) and 'Post-traditional communitarian' structure (Knorr-Cetina, 1999) means no one individual can know everything there is to know about their operational running. While allowing verification of findings between multiple experiments, such a structure can produce numerous difficulties when it comes to internal and external communications. One effect of this organisation on CERN is it has caused communication functions to be distributed across many groups. This was initially identified during the pilot study, particularly through the document analysis (Chapter 4, Section 4.2) with The CERN Communications Strategy, 2012-2016 (CERN, 2011), outlining this distributed communications function at CERN (In Chapter 4, Section 4.2, Figure 4.2). Within this document, it is made clear there is no overall communications policy that's applied across the whole of CERN and various experiments, with such policies almost impossible to implement given the independence of the experiments from CERN itself. This issue was further explored during the main study interviews.

While Knorr-Cetina's (1999) described the experiments as a 'post-traditional communitarian structure', with distributed responsibility and authority, a lot has changed since the time of her study. The development of procedures, such as those outlined in the CERN's Communications Strategies (see Chapter 4, Section 4.1, CERN, 2006; 2008; 2011), have gone some way to place authority and responsibility for the communication of results in the hands of the Communications Group. Yet, the Head of Communications outlines how the Director General has significant influence on the ability of the Communications Group to carry out their function.

> "When [The Current DG] came in, I knew him before, he was the leader of the collaboration I worked for back at the end of the 80's, beginning of 90's, and I thought he was very communication savvy. […] What I should have insisted on right at the start is you need somebody, strategic relationship management at the top who sits on the directorate. […] We know the lab, we know the physics we know how the

> physics community works, what we need is to position our brand our message out there in a competitive world where we are competing against a lot of other ideas."
>
> (Head of Communications, interview 04.02.14)

Part of the issue here is the separation of communications functions across CERN making it difficult to establish communications at a strategic level. As the Head of Communications describes above, there is a need to coordinate these various groups to help CERN achieve at a strategic level, primarily through the implementation of a top level manager who sits on the directorate. As Demb and Neubauer (1992) outline, such directorates play a crucial role in the implementation of strategies and are well positioned to provide advice to managers. With such a role would also come a shift in the positioning of communications functions across CERN.

The Web Manager further describes the distributed organisation of communications functions across CERN.

> "The Communications Group is attached to the DG unit, there's an Education and Outreach Group that's related to the PH [physics] department. On top of that it's really complicated because so many people at CERN communicate […] there are many forms of communication, social media, etc. So everyone's communicating but nobody is coordinating the communication. So that's a role the Head of Communications has been advocating for."
>
> (Web Manager, interview 06.02.14)

Currently, CERN's communication infrastructure is not clearly supported and promoted across CERN, making it hard for anyone new to get involved. This was exemplified in the case of the Experimental Physicist, who found it difficult to understand the complex nature of communications at CERN. Such coordination would benefit all those involved in communication activities at CERN, including physicists who want to get involved. As the Experimental Physicist described:

> "It's so big and there's so many different parties that you have to just slowly try and work it out. I find it difficult because I'm new to this. Even doing my coordination position, it's all very opaque to me, but everything seems to work so I don't want to be all pedantic and like, 'Well I want to understand everything and see how everything works', because everyone's a bit like, 'It doesn't really work like that'. You've got to be sort of like 'Well this is how everything works in this sort of way', and you've got of sort of get in with the streams, so that's what I'm trying to do really. So I'm learning, but still a lot of it is like, 'So how does this work?'"
>
> (ATLAS Experimental Physicist/Outreach Coordinator, interview 15.07.14)

Having communications clearly established at the strategic level would make people taking part in communication activities feel part of the broader communications network at CERN and make it easier for them to understand what their role is. Within Keyton's (2005) elements of organisational culture, this quote by the Experimental Physicist indicates a breakdown at a number of these elements. Without well-established communication policies in place across CERN, this has created breakdowns at Keyton's (2005) *basic* element, where various communication practitioners don't understand the functions of communication and their role as communicators within the organisation. Part of the issue appears to be around the sense of belonging to CERN as an organisation. As the Experimental Physicist describes, many of those titled 'CERN Users' do not feel part of CERN, having more loyalty to their collaboration and home institutes.

> "So my institute, I am ICTP[95], someone might be Sheffield etc., and that's very clear. Then when we come here we are [CERN] Users. You do get some fellows who are part of CERN, but none of us [Experimentalists], so we're just here using the facilities. It's probably one of the reasons you feel less, because you don't feel part of CERN. You don't feel like, 'I'm going to go and talk to my Communications Group or my Press Office. It's their Communications and Press Office'. It's different to my institute where I'm like, 'I'm ICTP so I will talk to them because we are on the same team'. With CERN, it's not that I don't feel we are on the same team, but it's definitely like I'm not CERN, so it's less accessible for me. I think that's normal with everyone."
>
> (ATLAS Experimental Physicist/Outreach Coordinator, interview 15.07.14)

As Porter-O'grady (1997) argues, effective communication within an organisation depends in part on levels of integration and inclusion. As the Experimental Physicist indicated, this feeling of separation means 'CERN Users' could be less likely to share information directly with the Communications Group as they do not feel part of the wider community. This

[95] International Centre for Theoretical Physics, http://www.ictp.it/about-ictp.aspx, last accessed 22.01.16.

demonstrates a breakdown at Keyton's (2005) *subjective* element, the inter-relationships throughout the organisation, caused by a breakdown at the *process* level, in this case, the horizontal lines of communication between experimentalists and the Communications Group. It's therefore difficult, to some degree, for a united vision or message to be achieved within the current organisation of CERN.

Again, many of these issues seem to have been recognised by the Communications Group, who have made numerous attempts to rectify such issues (CERN, 2011). While an organisation wide policy may not be achievable, the Communications Group has made steps to unite the various departments to try and achieve some coherence across their communications (through a top level Strategic Relationship Manager or equivalent, as outlined above).

Such coordination of communications at this top level would help centralise communications functions across CERN. As discussed in Chapter 2, Section 2.2.1, there are numerous benefits to uniting communications activities and disciplines within large organisations. As Cornelissen (2011) describes, there are economic benefits as it minimises the need and cost of continuous cross department interaction, with integration of various expertise helping to enhance the skill sets of communication professionals within departments. While such a strategic relationships manager has not been found, other steps have been taken.

> "I went to the Directorate Meeting with all the Heads of Department and said this is what we wanted to do and asked them to give me a contact point everywhere. So

> they can be invited to either give input into our quarterly meeting, or to come to it and tell us things from their side. We've also invited those same people to review the website, to see where they find content that's missing or out of date or anticipate content we will need in the future. So we are trying to do that."
>
> (Head of Communications, interview 04.02.14)

The response of the CERN management has been to create a Stakeholder Relations Office, bringing together those responsible for various communications functions. This, it was hoped, would help coordinate communications across the organisation.

> "Management has created a Stakeholder Relations Office that brings together the Heads of International Relations, Communications, Education and Outreach, and I think, Relations with International Organisations."
>
> (Web Manager, interview 06.02.14)

As described, the heads of department were also invited to review the CERN website, an area the Communications Group had identified as needing improving with the 2012-2016 Communications Strategy (CERN, 2011). As outlined by the Web Manager (Chapter 5, Section 5.6), CERN lacked a proper web architecture, with no restrictions as to who can create a website under the CERN banner, with content often unmanaged, outdated and difficult to find. A further outcome of this lack of structure and organisation of CERN's web presence is that many groups at CERN are poorly represented and may struggle to find tools and information relevant to them on the web.

> "One of the things we realised is that CERN people are really underserved in certain areas. So if you work in the CERN control centre and you're in charge of monitoring cryogenic systems, you are going to have really different needs from someone who's an administer who's managing someone's time schedule. Needs are so different and there are so many different types of people at CERN, computer engineers, civil engineers, physicists, theoretical physicists, experimentalists, and they've all got such different tool kits, they have all got different things, need different tools, different collaboration of tools. What we have at the moment is the CERN Directory that just lists the different tools you might need through the work day. We've been trying to build a personalised version of that."
>
> (Web Manager, interview 06.02.14)

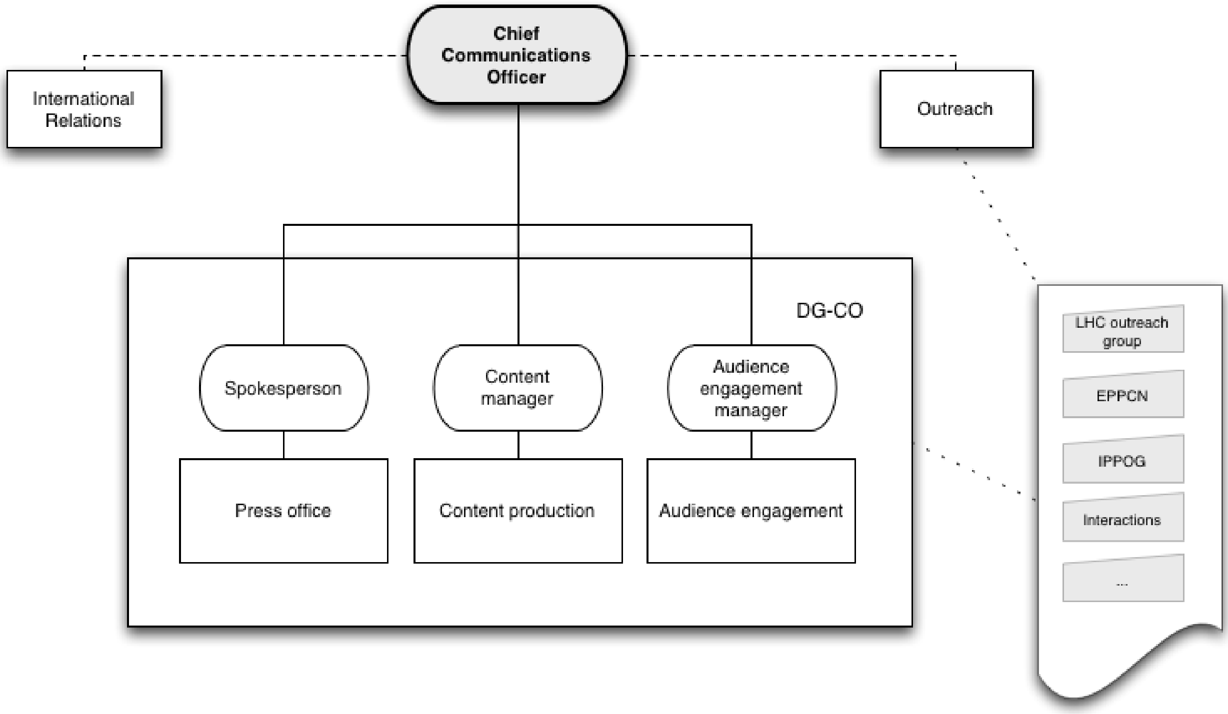
This is, once again, a challenge associated with an Adhocracy organisation (Mintzberg and McHugh, 1985) and multi-disciplinary research on a large scale (Guest and MacQueen, 2007). As Guest and MacQueen (2007) describe, within large, multisite, multi discipline research (such as CERN), many problems arise, especially around communication and the handling of data. What is required within such settings are access to the appropriate technologies that enable the data and information to be analysed, communicated and stored effectively.

Along with this personalisation of web tools, the Web Team, along with the IT department, have been looking at establishing better information policies at CERN.

> "We've been, the Communications Group and IT, have been advocating for some cross-over roles, such as Chief Information Officer, who we should have. It's a really important role in an organisation, it deals with somewhat boring, but also really important things, like information policy, so how do we look after data that is private. It's boring until something goes wrong then it is incredibly important […] So both the IT Department and Communications have been trying to advocate for these roles, cross-over roles both in terms of infrastructure an information policy and in terms of communications oversight."
>
> (Web Manager, interview 06.02.14)

Overall, it appears that the Communications Group is focused on improving many of these organisational issues they currently face. Part of this involves the restructuring of communications functions across CERN, moving from the current decentralised structure, towards a more centralised system that enables a greater coordination of strategic communications. This is summarised in Figure 7.1, taken from the 2012-2016 Communications Strategy (CERN, 2011).

Figure 7.1: The organisation of Communications at CERN, as proposed by the Communications Group (CERN, 2011).



Within this proposed system, personnel in other units whose roles involve managing relationships with target audiences and stakeholders (such as alumni) would become part of the audience engagement team. As outlined in Chapter 2, Sections 2.2.2, such a centralised system can bring multiple benefits, especially at strategic levels through clear and consistent messaging, as well as the sharing of resources and development of expertise and skills (Cornelissen, 2011). Yet, care needs to be taken by those involved not to shift too far towards a ‘command and control model’ of communications (Daft, 2012), which could have consequences on openness and engagement across CERN. Strategic guidance on communications and policies on technology use need to take into account the underlying culture of CERN, one grounded in openness.

7.2 Organisation of the CERN Communications Group

As the primary focus of this research, the organisation of the Communications Group was explored in great detail through the interviews. As with the spread and separation of communications functions across CERN, outlined in the previous section, a similar thing is true of the Communications Group itself, whose structure splits their various functions amongst various teams and individuals, located across CERN. As explored in the pilot study (Chapter 4, Section 4.3, Figure 4.1) the Communications Group is split into a number of sections, including the Press Office, the Web Team, Internal Communications, Social Media, *CERN Courier*, Audio Visual Department and Graphic Design Team, along with individual personnel dealing with communications for specific countries (i.e. UK, German and American Communications Officers). These teams and individuals are also located in various areas across CERN (Appendix A). This has created, as the Head of Communications and Web Manager explains, a silo mentality within the various sections of the group.

> "We identified one of our issues as being very silo, so I'm *The* [CERN] *Bulletin*, I'm the Press Office I'm the [CERN] *Courier*. So we wanted to get away from that."
>
> (Head of Communications, interview 04.02.14)

> "We work in silos of the Press Office, Audio Visual team, my team, *The* [CERN] *Bulletin*. We all work pretty independently, which is a real shame, I think there's a real opportunity to make things better there."
>
> (Web Manager, interview 06.02.14)

This silo mentality has in turn created a number of issues across the group. As the Web Manager explained, the lack of interaction has created tension between their team and other members of the group, especially when it comes to publishing of articles on the website.

> "The problem is we don't really work as a group. I don't know if you have seen that but there is not much movement, unless there's, at certain times there is, if there's a Press Release out and the Press Office comes to us. […] Sometimes it goes really badly. Back with the Higgs event, something had been prepared by other people in the group, and it wasn't written to a format and it wasn't written to an audience. So we couldn't put it on the website because it didn't fit anywhere, and we hadn't understood it had been written as a backgrounder for journalists. Then there was a lot of tension on the day, you know people saying 'Publish this on the website!' Then we have to have the conversation, 'Whose it for, does it fit in with other stuff?' I'm sure the other person felt like I had obstructed them, it's a real consequence of a lack of close working."
>
> (Web Manager, interview 06.02.14)

For the Web Manager, this separation has also created a lack of understanding across the rest of the group as to what his team actually does.

> "I think there's also a lack of understanding within the group of the technical issues we face. We are a funny kind of unit [the Web Team], in that we are the only technical unit really. I mean there is video production, so there's a mis-understanding

as to what we do, and because we work behind a close door, and don't complain too much."

(Web Manager, interview 06.02.14)

The current structure of the Communications Group, it seems, is creating issues at a number of Keyton's (2005) levels of organisational culture, especially at the *process and subjective* levels. The separation of the various members of the group has made sharing information difficult, which in turn has impacted on the groups inter-relationships, causing a lack of cohesion. To rectify such issues, the Web Manager would like to have greater interactions with the rest of the group on a more regular basis.

> "I would like to see more integration with more of the group. I don't mind an open-plan space where we are all together, I think that might help communications."

(Web Manager, interview 06.02.14)

While such a space would be virtually impossible at CERN at present, the Head of Communications is attempting to bring certain members of the group into one area, as part of the broader shift in communications functions across CERN, outlined above.

> "Another big change that will happen soon is that the creative team at the moment is in two places. Most of our writers, more than two places actually depending, most of our writers sit in the same office as the editor of *The Bulletin*, so the person who is responsible for the internal audience. They feel a great loyalty to *The Bulletin*. So we have quite a big writing pool, but [producing content for other channels] is a

> challenge. I want them to be in the same space as the photographers and video team. So we’ve got a company, an ergonomics company coming in in a few weeks’ time to talk to them and talk to me and to go away and give us a design for that space. So I think that will actually make a difference, when we put the writers and video people together physically in the same space, I think that would help to move from these silos.”
>
> (Head of Communications, interview 04.02.14)

Creating such open-plan spaces have proven successful in bringing together technical and editorial teams in similar settings. Robinson (2009) found the merging of digital teams with traditional print teams within newsrooms greatly improved relationships and collaboration between the two. Similar open plan offices have become the norm in many newsrooms, bringing together many forms of expertise into one space (Esser, 1998; Aviles et.al., 2009).

Until such open plan spaces have been established, the only time the group meet en masse is at the weekly editorial meeting. Previous research has demonstrated the importance of meetings within the editorial process of convergent newsrooms (Verweij, 2009), bringing together the various mediums within the newsroom to share information on content and production. Yet, as seen through the observations, the weekly meeting held by the Communications Group, involving various individuals involved in communications activities, have not always proved successful. Part of the current issue is the physical space available to the group for such meetings. The current space used for meetings by the group is a repurposed lounge. As the Web Manager explains, this space is not ideal, with meetings often becoming disjointed, unproductive and hard to manage.

> "The mezzanine is where we have our meeting. So the idea of the mezzanine is that it used to be someone's lounge, that's another story. So what used to be the lounge is now our meeting space. That meeting space is not available to anyone else at CERN, it's ours. So more and more I use it for meetings that require more people than can sit in my office."
>
> (Head of Communications, interview 04.02.14)

> "It's a good space if you want to talk to a group of five to six people, you want to share stuff, there's a projector. Good luck finding one elsewhere. What we tend to do is huddle around screens. I think physical meeting space is really underserved at CERN."
>
> (Web Manager, interview 06.02.14)

Throughout the observations, I saw this space used for meetings of various sizes. While well suited to smaller groups, the space was ill-suited for the number of people that attended the weekly editorial meetings. As the Internal Communications Manager and Web Manager explained, this meeting is attended by many people outside of the Communications, which, while allowing valuable interactions with various experiments and departments, often means 20-30 people are squeezed into this space.

> "In the editorial meeting we can see that we have CERN staff, but we also have people from outside or from other department that are also doing a bit of communications, pushing stories. So actually there are so many things happening all the time we can't cover everything, and at least through this meeting we try not lose any big thing."
>
> (Internal Communications Manager, interview 28.01.14)

> "I dislike mismanaged meetings. Some meetings gather an awful lot of people together and it's not clear why they are there. So quality meetings with well-managed, short focused meetings are extremely useful. […] I think one of the problems, talking about meetings being focused, there is a real lack of meeting space at CERN."
>
> (Web Manager, interview 06.02.14)

Although not a newsroom, holding such meetings once a week is quite a contrast to many digital newsrooms, who will often have such editorial meetings at least once a day (Robinson, 2009). Robinson (2009) also outlines how, along with these structured meetings, continuous communication and interaction is required throughout the day. It follows that the Communications Group could benefit from increased, structured interaction on a daily basis, especially when the members are so dispersed. This would help members identify and resolve issues and balance tensions between individual and group goals, as Lindlof and Taylor (2002) describe.

A further element that has occurred since the Pilot Study is the relocation of the Head of Communications away from his previous role running the Press Office and towards a more managerial role.

> "Increasingly my meetings are on group management issues, which is a good thing because the group, one of the challenges I've had with the group is that it hasn't been managed because I couldn't find the time to do that. […] I see them [The rest of the Communications Group] in a different way. So I go to the editorial meetings and I do have a weekly meeting with the content creation team."
>
> (Head of Communications, interview 04.02.14)

Yet this move has caused some additional issues within the group. As Hoogervorst (2004) argues, communication can be ineffective if certain barriers such as lack of collectivism, cultural differences, under-staffing and isolation of managers exist within an organisation. This appears to be the case to some degree within the CERN Communications Group, with some members feeling the move means the Head of Communications no longer understands the challenges they face. This was summarised by the Internal Communications Manager.

> "The problem is that he [The Head of Communications] is a layer up. He has physically moved, but its more, he's quite distant from where we are. So I'm not saying that he is closer to management, but he's definitely not at the level that we

> are, so the difficulties that we face every day are not necessarily visible even to him if you see what I mean.”
>
> (Internal Communications Manager, interview 28.01.14)

Once again, the measures suggested by the Head of Communications, in terms of restructuring communications within the group, should go some way to reducing the issues felt by the various members of the Communications Group. In particular, this restructuring should help the group achieve at Keyton’s (2005) process level by minimising the required channels through which communications needs to take place.

7.2.1 Summary

This section has outlined how the current organisation of CERN has created issues when it comes to communications, both across the institution and within the Communications Group themselves. Using Keyton’s (2005) levels of organisational culture, these issues are primarily due to a lack of clearly defined communication policies and the decentralisation of communications functions, again both across the organisation and within the Communications Group. To rectify some of these issues, the Communications Group have proposed a number solutions, including providing a clear mission statement (CERN, 2011) and the restructuring of their own group and the centralising of CERN’s communication functions.

While such measures could help those at CERN understand the role of communications within the organisation and cut down lines of communication, helping to achieve at Keyton’s (2005) basic level and process elements, care needs to be taken not to shift too far towards a ‘command and control model’ of communications (Daft, 2012). Instead of controlling, the centralising of communications functions could, as Cornelissen (2011) describes, help enhance the functional expertise and skill sets of media professionals within the organisation and allow more voices to be heard. A greater involvement with CERN Users as well, especially the members of the experimental collaborations, along with better organisation and higher priority for communication and engagement, could help in the development of strategies, policies and guidelines that take into the underlying culture of CERN, one grounded in openness.

7.3 Openness

Along with organisation, openness is another key lens through which the data was analysed. Through the analysis, openness was explored in two parts, through digital scholarly and professional processes and their outputs. Openness of processes explores the experimental procedures and handling of data during the research phase, along with and the mechanism through which information is released into the public sphere. Openness of products looks at how data, especially raw data, is shared at the end of the research cycle. As Grand *et al.* (2012) describe, digital scholarly practices can allow for real-time, open science through digital channels, providing opportunities for groups to engage with more than just the published results of science, but also with its processes, including methodologies, codes, models, and raw data (see also Holliman, 2011). Yet the nature of the research carried out at CERN makes such open practices problematic.

7.3.1 Open/Closed Scientific Processes

As outlined in Chapter 1, Section 1.3 with two detectors effectively searching for the same thing, openness is an issue during and after the research phase, with neither collaboration discussing details of their procedures or findings until they had been fully confirmed. This, in effect, creates a temporary 'black box' during the research process. This issue was explored during the main study through interviews with the theoretical and Experimental Physicists.

As the Experimental Physicist described, care had to be taken during the hunt for the Higgs to make sure information is not shared between the competing detectors, ATLAS and CMS.

> "So you have to stay schtum [during the research phase]. So we [ATLAS] saw a bit of the Higgs. CMS saw a bit of the Higgs. But we had to be incredibly, you can't talk about it. You have to be careful if you were talking over lunch, you would be like, 'We shouldn't talk about it in case CMS hear', or maybe there is a CMS friend in your friendship group, because you know there's a social side, hanging out with people and stuff. You've got to be careful not to talk about stuff you're not supposed to, so yea there was that secret thing."
>
> (ATLAS Experimental Physicist/Outreach Coordinator, interview 15.07.14)

In this respect, the process remains relatively closed during this time in order for data to be analysed and verified. Yet, while the specifics may be obscured during the research process, the methods themselves are made available, from which both collaborations, and High-Energy Physics more broadly, can benefit.

> "So all our methods, for example, are released in papers. So that's open. CMS and ATLAS are in massive competition, but we are not like 'Right we are not going to tell you what we are doing'. We make a new method and we publish it and CMS are like, 'Well that's interesting', and then they are like 'Oh we are going to use that'. Then they use it and they develop it, so it pushes it forward. So that is good for everybody, so you are like competing but then you are sharing. It's competition meets collaboration. It's a wonderful thing that science does. Then the algorithm just gets better and better as you share and improve it, and share and improve it, and then someone comes up with another idea and then that's shared. And now we've got amazing, the physics coming out now is really, really good, amazing results."
>
> (ATLAS Experimental Physicist/Outreach Coordinator, interview 15.07.14)

This transfer of knowledge is also achieved through the likes of CERN's Open Hardware License[96], established in 2011. The Open Hardware Initiative allows the exchange of knowledge between various fields through licensing of hardware designs developed at CERN. As Grand *et al.* (2012) describe, opening up scientific methods to wider audiences has implications for science and public engagement with science. Here, digital practices can take this further, allowing us to see how 'black boxes' (Latour, 1999) are constructed through open processes. Yet, the complex nature of the research process, and quantity of data

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[96] CERN launches Open Hardware initiative, http://press.web.cern.ch/press-releases/2011/07/cern-launches-open-hardware-initiative, last accessed 22.01.2016.

produced by the experiments, at CERN make it difficult for most external, non-expert audiences to engage with it.

The experimentally justified need for concealment of data during the research process can also create issues for the Communications Group.

> "So when we talk to, when Communications ask is there something big we need to know about, that's a bit difficult isn't it, because we can't be like, 'Well there's this and this'. We do have emails where we are like, 'This is confidential, these are the things', but these are generally things that aren't big news, but like we will say before the conference these things are probably going to come out […] So we tell them what's what. Then CMS do that privately as well and they [the Communications Group] are supposed to be very, they are, they are never going to be like "Oh ATLAS told us this."
>
> (ATLAS Experimental Physicist/Outreach Coordinator, interview 15.07.14)

As outlined in Chapter 4, Section 4.1, Figure 4.1, the communication flow prior to release relies on the experiments triggering the process by informing the Communications Group about results. Yet this process doesn't always run as smoothly. Researchers can go directly to journals without informing the Communications Group. In such circumstances, the Communications Group rely on their relationship with external journals to find out from them what has been said. This was evident with the *Nature* embargo, as the Head of Communications describes.

"*Nature* now tells us what they've been told, because the scientists they often think, with the *Nature* embargo, we can't tell the Communications Group. When I write to them [the scientists] and ask, 'What about this Nature story?' They go, 'Who told you about that?!' '*Nature* actually'."

(Head of Communications, interview 06.02.2014)

As such, while the seemingly linear process outlined in Figure 4.1 doesn't always run as planned, the additional barriers in place, such as the Group's relationship with journalists, allows them to stay in control of this process. The Communications Group also has the power within this process to decide what/how information is released into the public sphere. Such power, however, can create conflict between the experiments and the Communications Group. One example from the Head of Communications came after new details regarding the Higgs was confirmed by the ATLAS experiment. The result from November 2013 was the first evidence of the Higgs Boson coupling with matter particles[97]. With the result, the outreach groups of the experiments wanted a Press Release and press conference, much like the event done for the original Higgs update in July 2012[98]. The CERN Communications Group, however, felt the result didn't warrant such an event. They argued that the results were only significant to high-energy physicists. As such, the Communications

[97] Atlas sees Higgs Boson decay to fermions, http://home.cern/about/updates/2013/11/atlas-sees-higgs-boson-decay-fermions, last accessed 22.01.2016.

[98] CERN experiments observe particle consistent with long-sought Higgs Boson, http://press.web.cern.ch/press-releases/2012/07/cern-experiments-observe-particle-consistent-long-sought-higgs-boson, last accessed 22.01.2016.

Group decided to limit communications to social media and the *CERN Courier*, where it was picked up by some of the more scientifically-minded, specialist journalists. This example again demonstrates the Agenda-Setter (Fahy and Nisbet, 2011) role of the Communications Group. The decision not to put out a Press Release was not popular with the experiments, with the Communications Group still wondering if they did they right thing.

> "What I'm not sure is, should we be trying to, we say we want to tell the story of how physics and science happens, should we be trying to get that across to journalists as well?"
>
> (Head of Communications, interview 06.02.14)

Overall, these examples throw light on some of the key issues surrounding openness in the various digital scholarly processes carried out during the research and communication phases. While the potential of digital technologies to create 'open science', particularly with the opening up of the research process, has been well discussed (Grand *et al.,* 2012), in practice such principles are difficult to achieve, influenced by the nature of the research being carried out. At CERN, the nature of the work carried out restricts open practices during the research phase, with concealment needed, e.g. between rival experimental detectors. This has a knock on effect on communications procedures, where information sometimes does not reach the Communications Group until the last minute, once data has already been reviewed and ready for publication. The Communications Group must then coordinate the release of information, utilising their communications network to try and achieve simultaneous release. In this respect, timing of openness is built into CERN's strategy, and embedded in day-to-day practices.

7.3.2 Open/Closed Products

The biggest issue in terms of openness that appeared throughout the interviews was that of open data. While the sharing and reusing of such raw data is central to the open science movement, there is clearly some resistance to such practices within High-Energy Physics and the experiments at CERN. While open access journals and publications have become the norm within High-Energy Physics (Mele, 2009), the raw data behind results often remains obscured. The sharing of such raw data appeared to be a contentious point between the experimental and theoretical physicists at CERN, with debates to how much, if any, data should be released and the potential impact of its release.

> "Some people are very like we shouldn't be giving any of it out, it will destroy everything, and other people are like we should be open, it should be for everybody."
>
> (ATLAS Experimental Physicist/Outreach Coordinator, interview 15.07.14)

> "They are very careful about what they release. There is a permanent sort of debate where theorists would like more data so they can do more themselves, whereas experimentalists like to give less out […]"
>
> (Theoretical Physicist, interview 17.07.14)

Much of the fear surrounding the release of the data is around protecting the integrity of the science, making sure it's kept to a high standard, the concern being theorists could misinterpret the data. The distrust between experimentalists and theorists, which first became apparent during the observations (Chapter 5, Section 5.8.2), seems to make experimentalists very protective over the data.

> "They [theorists] could be like, 'I looked for this model and I saw these jets'. You would be like, 'Yes, but you didn't recalibrate your electron efficiency?' You know, there is so much stuff, but we work on it all the time so we understand, we have people who have worked on it for years and they understand it. Anyone can just be like, 'Oh look, I've found this new particle', and that would be bad for science, because then we would be like, 'Oh no they haven't'. So this is the problem, people will end up publishing stuff that is incorrect and bad science because you need to have this internal peer review and learning from each other."
>
> (ATLAS Experimental Physicist/Outreach Coordinator, interview 15.07.14)
>
> "They [Experimentalists] don't trust other people to properly interpret the data, which is partially true, of course, because the data might be difficult to interpret because it is measured by certain measurement devices, in certain corners, certain signal regions say, a detector might work a lot better than another, and you have to somehow unfold all the detector simulations from your data, and this might be difficult to do in general. So experimentalists could give us such data but they don't like to do it very much."

(Theoretical Physicist, interview 17.07.14)

As these the quotes demonstrate, for data to be used (or reused) effectively, more than just the raw data itself is required. Information regarding the whole method is needed so further work can be carried out, in this instance, by theoretical physicists. Out of context, raw data would lead to inaccurate models/theories. As Collins (1985) describes, this notion of openness and especially replication of scientific results is not straightforward, especially within an experimental 'Adhocracy' (Mintzberg and McHugh, 1985), where no one person can know everything there is to know about experimental procedures. Similarly, as Borgman (2007) found, the effort needed to document the research process often prevents scientists releasing such information.

7.3.3 Summary

This section has explored openness in processes and in products. Examining openness in these two ways has highlighted a number of difficulties when it comes to open practices within High-Energy Physics. As Hanson *et al.* (2011) outlines, open practices will be influenced by the specific field and attitudes towards such practices. Within this study, it was clear the nature of HEP research has a major influence on open practices across CERN. As outlined in Chapter 1, Section 1.3, the competition between two detectors, ATLAS and CMS, limits openness during the research phase, with neither collaboration discussing details of their procedures or findings until they had been fully confirmed. Yet, while the specifics may be obscured during the research process, the methods themselves are made available, through open access publications and open hardware licenses, from which both collaborations can benefit.

When it comes to openness of products, while open access publications have made the final, peer reviewed results of the research generally available, the issue at CERN is the release of raw data. As described, the sharing of such data was a contentious point, especially between the experimental and theoretical physicists, with debates as to how much, if any, data should be released. The primary fear is how the data would be used by those outside of the experiments, and the inaccurate theories that could result from an improper understanding of experimental procedures. In this instance, open data relies on open methods.

Overall, this thesis has demonstrated a number of factors that can influence open practices within HEP. With this comes a number of implications for HEP in the public sphere. As this study at CERN has demonstrated, when it comes to openness, timing is everything. With the nature of the scientific work carried out at CERN requiring concealment during the research phase, openness is limited to the end of the research cycle, once the data has been reviewed and ready for publication. Timing of openness is also built into CERN's Communications Strategy (CERN, 2011) and embedded in the day-to-day practices of the Communications Group, who use their communications network (and sometimes embargos) to coordinate the release of data and make sure the scientific community is informed of results before the media. As such, openness is inevitably partial within such HEP research. This is not only in terms of the timing of openness, but also in terms of who can access information. With the tools and technologies required to access and interpret data out of reach of most publics, such information is somewhat restricted to others in the scientific community. However, the Communications Group are in a position to facilitate meaningful 'upstream engagement' (Wilsdon & Willis, 2004), through open practices that enable broader sections of society to engage with research at an earlier stage (see the Head of Press case, Chapter 5 Section 5.4).

7.4 Conclusion

What became clear throughout this look into CERN's communication organisation is the need for further investment/restructuring into CERN's communication infrastructure to help improve all aspects of communication, both internally and externally. As outlined in this chapter, CERN's current structure has created issues at a number of Keyton's (2005) levels of organisational culture, primarily at the *basic* and *process* levels. As first identified within the pilot study (Chapter 4, Section 4.1), CERN lacks the organisational wide communication policies and clear mission statements that underpin Keyton's (2005) basic element. As demonstrated by the Experimental Physicist, the lack of such clear strategies makes it difficult for new and/or existing communication practitioners, especially those from the physics community, to understand the purpose of communications at CERN and their role as practitioners.

In contrast, the CERN Communications Group achieve well at the basic level, with each member having clearly defined roles and working practices. However, changes to the role and physical location of the Head of Communications is bringing about changes in the way the Communications Group will function. This cultural change, including the reorganising and repositioning of members of the Communications Group, is likely to bring with it some difficulties as the roles of the members become blurred.

Across CERN, and within the Communications Group, numerous issues were seen at Keyton's (2005) process element, the formal and informal channels through which information is shared, primarily down to the decentralisation of communications functions across the organisation and within the Communications Group. In both cases, this decentralisation requires multiple lines of communication to effectively share information, creating a complex communication infrastructure. Where lines of communications are ineffective, information can be missed or delayed, making it difficult for the Communications Group to carry out their function. This complicated communications network has in turn created issues at Keyton's (2005) *subjective* and *satisfaction* elements, where individuals, particularly CERN Users, may have divided loyalties. In turn, CERN Users may be less likely to interact with members of CERN, including the Communications Group.

In terms of openness, this chapter has demonstrated how the nature of the scientific work carried out at CERN has impacted on levels of openness. While the notion of open science calls for the sharing of data and methods during the research process, such practices are often unachievable at CERN, with the competition between experiments that drives the science forward. This competition and need for concealment during the research phase can also impact on the ability of the Communications Group to carry out their function. Researchers may be reluctant to share with the Communications Group in case the information reaches their competitors. In instances where information bypasses the communication process (outlined in Chapter 4, Section 4.1), the Communications Group relies on their relationship with external communication professionals to inform them as to what they've been told. Such relationships are therefore crucial for the Communications Group, allowing them to maintain a hold on information coming from the experiments.

Overall, this chapter has outlined how the current organisation of CERN has created numerous issues when it comes to communications across the institution, primarily through a lack of clearly defined communication policies and decentralisation of communications functions across the organisation and within the Communications Group, and the factors that influence openness at CERN. These issues appear to have been acknowledged by the Communications Group, who have in turn attempted to rectify a number of them. The 2012-2016 Communications Strategy (CER, 2011) provides a clear, well defined mission statement, a number of strategic themes and key messages with recommendations for changes in governance at CERN. This would help those at CERN understand the role of communications within the organisation, helping to achieve at Keyton's (2005) basic level. The Communications Group has also outlined additional strategies to move away from the current decentralised communication organisation of both the group and CERN as a whole, towards a more centralised system where communications can be better coordinated. This in turn can help improve the situation at Keyton's (2005) process element by cutting down the necessary lines of communications between those involved in communications. However, care should be taken not to shift too far towards a 'command and control model' of communication. Instead, with this centralising of communications functions should come the development of strategies, policies and guidelines that support groups and individuals in their own communication and engagement practices.

Chapter 8 Conclusion

As discussed in Chapter 1, the digital age has brought with it changes to the ‘traditional’ communication process, with digital technologies providing channels through which producers’ can reach ‘consumers’ of knowledge more directly (Holliman, 2011; Allan, 2006). Rapid changes in practices have not been without their challenges, however, for academics, PR professionals and journalists. In particular, the role of traditional mediators of scientific information has, to some degree, been replaced by the work of those within scientific institutions themselves (Holliman, 2004; 2000).

With a review of relevant literature highlighting a gap in the understanding of the role of such public relations groups in the mediation of High-Energy Physics information, this thesis set out to explore how CERN’s research becomes public in an era of digital scholarship. A particular focus has been on the strategic significance and organisational practices of the CERN Communications Group. This was explored through a mixed method approach, combining document analysis (Bowen, 2009), semi-structured interviews (Spradley, 1979) and observations (Hammersley, 2007), tracing the working practices of the CERN researchers and professional. To explore this effectively, multiple frameworks from a diverse range of fields were used within this thesis. Fahy and Nisbet’s (2011) typology of science media professionals was used to explore the function of the CERN Communications Group (Chapter 2, Section 2.4.5). Where public relations practices became apparent Borchelt and Neilson’s (2014) levels of public relations were used to examine their effectiveness (Chapter 2, Section 2.4.7). The impact of CERN’s organisation on the ability of the CERN Communications Group to carry out such functions was explored through Keyton’s (2005) model of organisational culture (Chapter 2, Section 2.2). Finally, Miller *et al's.* (1998) Circuit of Mass Communication provided the model to demonstrate how various actors interact to construct and interpret scientific information (Chapter 2, Section 2.5).

Along with this exploration into science mediation, this thesis has examined how digital scholarly practices (Weller, 2011) are enacted within a High-Energy Physics institution. Along with Weller's (2011) definition of digital scholarship (Chapter 2, Section 2.4), Grand *et al's.* (2016) typology of digitally engaged researchers was used to trace the use of technology by participants, identifying how digital scholarly practices are enacted within a digitally mediated ecosystem. The research presented in this thesis demonstrates that a muddling of open and engaged practices exists at CERN, with no clear distinction over whether forms of communication and engagement, mediated via technology, count as legitimate work. In doing so, this thesis adds to the growing discussion in a number of fields, including the role of scientific public relations in the process of mediation of scientific information and how digital scholarly practices are enacted within a 'big science' project.

This Chapter continues with a summary of the key findings of this thesis, outlining the key contributions to knowledge. This is followed by a review of the methodological approach used within this thesis, discussing the suitability of the approach and possible improvements.

8.1 Key Findings and Contributions to Knowledge

This section summarises the key findings from this thesis, helping to outline this study's contributions to knowledge. Along with methodological recommendations and considerations for future research, findings from this thesis have contributed to a number of areas. These contributions have been grouped alongside the relevant Sub-Questions in this thesis, which together provide an insight into the main Research Question, 'How has the concept of openness, and the emergence of digital technologies, influenced the organisational culture of CERN and the practices of CERN researchers and communications professionals?'.

- *How does CERN's 'Adhocracy' organisation impact on communication practices and openness?*

As outlined in Chapter 1, Section 1.3, the nature of CERN's experimental collaborations and their 'Adhocracy' (Mintzberg and McHugh, 1985) and 'Post-traditional communitarian structure' (Knorr-Cetina, 1999) means no one individual can know everything there is to know about the experiments. While this allows verification of findings between multiple experiments, this structure produces difficulties when it comes to internal and external communications. These issues were explored in Chapter 7, using Keyton's (2005) pyramid model of organisational culture (Chapter 2, Section 2.2) as a theoretical framework to explore the communicative behaviour of the organisation and of the Communications Group.

Characteristic of an Adhocracy organisation (Mintzberg and McHugh, 1985) is the semi-informal coordination, with little direct supervision and standardisation. The evidence presented in the thesis shows this to be the case with the experimental collaborations, with effects being felt across CERN more broadly, particularly in terms of communication procedures, strategies and web infrastructure. At Keyton's (2011) basic level, the communicative artefacts at the centre of the organisation, a number of issues were identified across the organisation. As demonstrated within the pilot study (Chapter 4, Section 4.1), CERN lacks a communication policy that has been fully embedded across the whole organisation. As a result, individuals, including some communication practitioners and some CERN users (the latter a transient population), do not always understand the functions of communication and their role as communicators within the organisation. This was particularly apparent within the Experimental Physicists case study, who had found it difficult to understand the complex nature of communication and where she fitted in as Outreach Coordinator. Similarly, the lack of policies and protocols for websites has created a number of issues for the Web Manager. As described in Chapter 5, Section 5.6, the web at CERN has been built up on an ad-hoc basis. As such, there has been a lack of consistency and coherence, with unmanaged websites and information.

Overall, this thesis has demonstrated how the strategies, governance and organisation of a research institution will influence communication and openness. While the adhocracy organisation of CERN is important when it comes to ensuring the verification of scientific results, it also created numerous issues in terms of communication, with a lack of standardisation of processes and absence of formal strategies. The lack of a clearly defined hierarchy and positioning of communications can lead to information being missed or ineffectively shared. During the time-span of this thesis, the Communications Group had already begun addressing some of these issues, through changes in web infrastructure and the remodelling of the Communications Group. Many of these changes involve centralising communication functions within CERN, shifting towards a more 'command and control' (Daft, 2012) approach to communications and web infrastructure. While this could help mitigate some of the issues identified within this thesis, care should be taken within a digitally mediated ecosystem. A flexible approach is also needed in the digital age, balancing between the institutions formal organisation, official policies and the needs of individual digital scholars and groups. As seen in other research institutions, instead of focusing on controlling practices or imposing solutions, communication and engagement professionals should provide advice and supportive policies that allow researchers to define engagement, identify their own publics and engage in their own way, creating 'consistency within diversity' (Holliman *et al,* 2015). For this to occur, continued investment and increased institutional support for communication activities and procedures, including the adoption of future communications strategies, could help make communication a higher priority at CERN. More is also needed to bridge the gap between CERN Users and the Communications Group, to improve information sharing within the organisation and beyond into the public sphere. To achieve this, communications strategies need to take into account the culture that underpins the research carried out at CERN, providing tools and guidelines that are inclusive and supportive of the wide range of individuals at CERN. This could be achieved through a CERN wide 'needs analysis', aimed at identifying initiatives that could improve communication and engagement (Holliman *et al.,* 2009). Greater training and support for those wanting to communicate and engage, provided by the Communications Group, and reward mechanisms that encourage greater involvement from the wider CERN community could also help bridge the gap between CERN Users and the Communications Group and improve information sharing. This could also help improve the view of communication and engagement as more than just a hobby, done by a few enthusiastic researchers in addition to their scientific work, and see it instead as an integral part of a researcher's role.

- *Where does the CERN Communications Group sit within the organisation?*
- *How does CERN's communications architecture impact on communication practices and openness?*

CERN's communications architecture refers to the network of channels and means through which groups or individuals at CERN communicate both internally and externally. This was particularly relevant to Keyton's (2005) process level, the formal and informal channels through which information is shared. As revealed through the document analysis, CERN has a rather decentralised communications network, with multiple groups able to communicate on behalf of CERN. This decentralisation requires multiple lines of communication to effectively share information across the organisation, creating a complex communications architecture. As described in the pilot study (Chapter 4, Section 4.2), this decentralisation, with multiple groups able to communicate on behalf of CERN, can make it difficult for CERN to present a coherent message and coordinate communication at a strategic level. While this is in part down to the nature of a globally distributed academic institution, steps can be taken to minimise these issues. A shift towards a more centralised communications architecture could enable a greater coordination of strategic communications. This shift has, to some extent already begun at CERN. At the start of this project, the Communications Group sat within the Director General Unit, along with Internal Relations and Host Relations, while others, such as the Education and Outreach Unit, were under the Physics Department. Since the setting up of the Stakeholder Relations Group (Chapter 7, Section 7.1) in 2014, the Education and Outreach Unit has moved to the DG unit, bringing them closer to the other teams with communications functions. While the groups have not merged, the move could help CERN manage and sustain relationships with key audiences.

The question still remains, however, if a centralised approach to communication is the best fit for a large, distributed organisation such as CERN's. It could be argued that having multiple groups with different messages is inevitable within such organisations, and, if supported and guided correctly, could be a powerful tool through which to reach increasingly diverse publics and stakeholders. The opportunity is there for CERN to embrace such a pluralistic approach to communication, with communication professionals responsible for checking the quality and accuracy of any communication coming from the groups, rather than controlling the whole process themselves.

- *How does the nature of the work carried out at CERN impact on the function of the Communications Group?*
- *How does the nature of the work carried out at CERN impact on openness?*

As discussed in Chapter 7, the nature of the work carried out at CERN plays a major part in communications and relative or structured openness. The primary issue throughout the thesis was the need for concealment during part of the research phase, due to the competition between experiments driving the science forward. Such practices have been seen in other scientific fields. The competition between the government funded Human

Genome Project and the privately funded Celera Genomics, it is argued for example, accelerated the publication of the first working draft of the Human Genome sequence (Dagnio and Rocco, 2009). At CERN, this competition impacts on the timing of openness and the ability of the Communications Group to carry out their function.

In terms of open practices, Hanson *et al.* (2011) outlines how this will be influenced by the specific field and attitudes towards such practices. This thesis has demonstrated how the nature of the HEP research carried out at CERN has impacted on certain aspects of openness. Within this thesis, openness was explored in terms of processes (conducting the research) and products (publicising the results). Examining openness in these two ways highlighted a number of difficulties when it came to open practices within HEP research.

In terms of processes, the competition between the detectors at CERN limits openness during the research phase, with no information released until the data has been fully analysed and verified. This need for concealment effectively puts a timestamp on openness for the end of the research cycle. This timing of openness is reinforced within strategic documentation and communication processes, which intend to keep information within the scientific community before releasing it into the wider public sphere. Yet, while the specifics may be obscured during the research process, certain products are made open, such as peer reviewed papers and experimental techniques, through open access publications and open hardware licenses, from which HEP can benefit more broadly.

When it comes to openness of products, while open access publications have made the final, peer reviewed results of the research generally available, the release of raw data is limited. One of the reasons, as described by the Experimental Physicist (Chapter 5, Section 5.7), is the fear of inaccurate theories or models arising from improper analysis of the data, which may fail to take into account the specifics of the experimental method. This is, in part, down to the 'Adhocracy' (Mintzberg and McHugh, 1985) organisation of the collaborations, with the size and complexity of the experiments meaning no one person can know everything there is to know about specific research procedures. Collating all the required information to make accurate theories or predictions would be a mammoth undertaking, requiring a range of knowledge and expertise. As such, creating open products that can be used meaningfully by other experimental and theoretical groups, or those outside of HEP, is a challenge. Furthermore, even if products and associated information are made available, the tools and expertise required to use store and analyse products may not be available to many publics outside of experimental collaborations, limiting the scope of such open practices.

The nature of the work carried out at CERN has further impacts on the Communications Group. With the Communications Group relying on the experiments to inform them of upcoming results, the concealment of results until they have been internally verified means the Communications Group can be left with little time to prepare Press Releases and media events. The solution to this challenge is some form of embargo where PR professionals prepare information and journalists await this information before going public. This system is not without its critics, however, as it could encourage 'Churnalism' (Davis, 2008), the passive processing of embargoes, rather than encouraging critical journalism, raising questions as to the role of journalists as a 'fourth estate' (Lewis *et al.,* 2008).

In instances where researchers bypass the Communications Group and go straight to external journals or the press, the Communications Group rely on their relationships with journals and media professionals to stay on top of this process. The Communications Group, therefore, have to be both proactive and reactive when it comes to communicating information, proactively building and maintain relationships with external media professionals while reacting efficiently and effectively to stories and information from the experiments as they arise.

Overall, this thesis has shed some light on how the nature of research process can impact on communication practices and openness. When it comes to openness, this thesis helps demonstrate how open ideas and open practices may not be applied universally, but need to take into account the nature of the discipline and the research itself. It's the case at CERN that openness will inevitably be partial within such large scale, competitive research institutions. This is true in terms of the timing of openness and the scope of openness. While those within the HEP community can benefit from certain open practices, such as open access publication, the tools and technologies required to use such data aren't available to wider sections of society.

When it comes to the dissemination of results, in situations like CERN's and HEP, those responsible for communications need to establish strong relationships with researchers in their institutions to be in a position to communicate effectively. Creating better relationships can help the Communications Group pre-empt upcoming stories, giving them more time to prepare relevant information subsidies (Gandy, 1985). Central to this relationship is trust, with the experimental physicists needing to trust the Communications Group not share information with anyone else, especially the other experiments, and the Communications Group trusting the researchers to provide them with accurate and timely updates from the experiments. This relationship and the communication process should be clearly defined within communications strategies, and made public.

- *Do CERN communication professionals require scientific backgrounds?*
    - *How does the background effect their working practices?*

Of the six members of the Communications Group involved in this study, two had been educated to PhD level in physics (Head of Communications and Internal Communications Manager), while the others had backgrounds in science communication and science writing. As Dunwoody (2004) describes, some science knowledge is valuable to a science journalist, but not essential, with knowledge gained 'on-the-job' also extremely valuable. While a communication professional with a scientific background could help improve discussions about science in the media through the production of sophisticated and accurate information subsides, scientists may be too close to the research to be independently critical (Dunwoody, 2004). Instead, having a scientific background could allow such communication professionals to add to the popularisation of science and allow scientists to further maintain/control the public image of science.

Across the CERN Communications Group, three of the members were educated to postgraduate level in physics, allowing them to deal with the majority of questions they receive without calling on the physics community. While a physics background is not essential, a science background can prove useful within the setting, allowing communication professionals to deal with a wider variety of articles. For the Internal Communications Manager in particular, her scientific knowledge helps mitigate the stereotype she feels exists within physics, whereby a woman would not understand such complex scientific research. Such stereotypes have been reported in previous studies (Hazari and Potvin, 2005). Similarly, the Internal Communications Manager feels many researchers seem to think communication professionals would not understand science, another well documented issue (Hartz and Chappell, 1997; Peters, 2013). As such, her scientific background gives her the credibility she needs to deal with various CERN researchers.

The Internal Communications Manager's case also demonstrates how a science background can impact on working practices. While this question originally related to how a science background would impact on any impartiality, it became clear that this was not particularly relevant within this thesis. Fahy and Nisbet's (2011) typology of media professionals revealed the primary function of the group was to act as advocates for CERN rather than to provide a critical perspective on the research carried out there. This does raise questions, however, as to who is providing critical reporting on CERN? As discussed in Chapter 2, Section 2.4.5, with the growth of the public relations industry in the sciences and reliance of information subsidies by journalists is compromising the 'fourth estate' (Lewis *et al.,* 2008). Yet, there is potential for the 'fifth estate' (Dutton, 2007), the network of individuals primarily connected through digital technologies, to fulfil this function through the work of independent science bloggers, which could include bloggers from experimental collaborations themselves, providing a critical perspective.

A further trend apparent with the physicists turned communicators is their attitudes towards work/life balance. Those 'Net Generation' (Tapscott, 2005) of workers, such as the Internal Communication Manager, use digital technologies to work flexibly and maintain virtual connections with colleagues. Yet, this approach is not favoured by all within the group, with those such as the Social Media Manager and UK Communications Officer preferring to stick to a more traditional, 9-5 working pattern. What appeared within the Communications Group was a muddled culture (Grand *et al.*, 2016) of professionals with varying attitudes towards working practices and technology use (discussed further under Question 7). While communities can benefit from such mixed ecosystems (Grand *et al.*, 2016), through the mixing of skills and competencies, this can cause challenges when individuals work across communities. Tensions can be created when forms of digital scholarship interact with forms of professional practice. This in turn could have consequences on the ability of the Communications Group to carry out their function. With the physicists in this thesis reporting that the physics community work 24 hours a day, seven days a week while the machines are running, events could occur in the evenings or over weekends which may then be missed/not communicated in a timely manner, or may get out of hand, a potential risk to the reputation of the organisation. As such, within big science projects, particularly those with a globally distributed network of researchers, a 24/7 communication function may be inevitable.

- *How have digital technologies impacted on the communication practices of researchers and communication professionals working at CERN?*
- *How are digital technologies used for engagement purposes by CERN researchers and professionals?*
- *What factors influence the use of digital technologies by CERN researchers and professionals?*

The notion of digital scholarship (Borgman, 2007; Weller, 2011) (Chapter, Section 2.4) and Grand *et al's*. (2016) typology of digitally engaged researchers provided a means through which the impact of digital technology use by researchers and professionals could be traced. Palmer *et al's.* (2009) scholarly primitives were also used to explore the various academic practices of the Theoretical Physicist (Chapter 7, Section 5.8). Within this thesis, digital scholarship described how digital technologies could be used not only for research and working practices, but to connect various parties in formal and informal ways, informing, educating, entertaining. Grand *et al's*. (2016) typology of digitally engaged researcher was adapted to broadly categorises users based on their use of technology during these practices.

Throughout the observations, numerous digital and analogue technologies were used by the various participants to communicate with colleagues. The main analogue and digital communication channels were face-to-face, email, the telephone, social media and Skype™ (Skype™ also includes its Instant Messaging function that was used in a number of cases). While all manner of technologies play an important role in information sharing in the digital age, face-to-face communication is still heavily relied upon. Face-to-face was the preferred method of communication when it came to interactions with co-located users and when dealing with sensitive information, while emails supported dispersed colleagues and the dissemination of information to a wide number of people simultaneously. Yet the biggest impact seems to have come from the use of more informal digital tools, such as Skype™ and social media, which again allows dispersed colleagues to stay in touch, but also facilitates the more social aspects of communication. Such social technologies were also used to engage with external audiences, such as the use of Google Hangouts™ by the Social Media Officer (Chapter 5, Section 5.1).

The use of digital technologies to engage various audiences is a central aspect of digital scholarship. At its most engaging, the social media manager was able to use digital technologies to facilitate a direct connection between two geographically separate groups, CERN researchers and American High School students (Chapter 5, Section 5.1). The use of social media, in this instance was similar to Veletsianos and Kimmons (2011) notion of 'Networked Participatory Scholarship'. In a similar fashion to that seen at CERN, Veletsianos (2012) found academics used social networking tools, in their case Twitter™, to connect students with professional communities outside of the classroom. The Communications Group, therefore, play a broader role in facilitating digitally-mediated engagement, along with traditional communication practices. Examining the motivations behinds this engagement at CERN revealed Instrumental, Normative and Substantive motivations (Wilsdon & Willis, 2004), with dialogue between the students and researchers encouraged, allowing the impacts of CERN's research to be discussed.

A further example of the group embracing open and engaged practices came from the Head of Press. Here, the Head of Press used contacts with local authorities, communities and journalists to inform them of an upcoming Press Release regarding a potential new collider at CERN. This appeared to be an example of 'upstream engagement' (Wilsdon & Willis, 2004) where discussions around complex scientific issues are initiated with publics in the early stages. Yet, while such engagement can be used to make science more democratic among publics, in this instance the decision seemed to be primarily *Instrumental*, with the group wanting to inform these stakeholders about what was coming up in order to avoid a negative reaction in the future. There were no clear *Substantive* motivations, as it doesn't appear they were looking for input from local stakeholders at this point in time (although this may be planned downstream), rather just to inform about what could occur.

This thesis provided examples of how digital technologies, especially social media, can be used to create meaningful engagement between researchers and various publics with HEP. Yet it is important to establish the motivation behind such engagement in order to understand the impact of such interactions. Further steps could be taken to encourage and support the use of social media and other digital technologies to engage with various audiences. Across the cases, however, it became clear that digital technologies had not come to replace traditional analogue technologies and practices. Instead, digital technologies/practices have blended with analogue in many cases, depending on a number of factors, such as those outlined by Mark and Poltrock (2004).

The blending of analogue and digital technologies was also apparent within the scholarly practices of the Theoretical Physicist. Using Palmer *et al's.* (2009) scholarly primitives, both analogue and digital technologies were used to fulfil a number of these primitives, including *Scanning, Assembling, Co-authoring*, *Coordinating*, *Disseminating*, *Consulting, Networkin*g, *Monitoring, Note taking* and *Data Sharing.* According to the Theoretical Physicist, additional collaborative activities, such as *Coordinating*, *Consulting* and *Networkin*g, while observed as face-to-face activates, could also be facilitated through digital technologies, particularly email and Skype™, allowing geographically disperse groups of researchers to collaborate and exchange information.

Across the cases, factors such as the organisational context, the individual's role, the individual's needs and the specific task influenced the use of technologies by the participants. Through the observations, it also became clear that the features of specific technologies had an impact on how and when they were used. As Peters (2006) describes, these features focus around the ability to control who information is shared with (Control of Contact), and the amount of information that can be shared and how it can be interacted with (Control of Content). Within organisations, Peters (2006) describes how emails support groups whose members are dispersed, such as the Communications Group. As such, emails were the preferred communications method for many of the participants, including the

Internal Communications Manager who is able to assign priority to each message and control the contact she has with others.

Munkejord (2007) also outlines how the combining of tools and technologies will be influenced by task complexity, contextual or situational constraints and the tools that are available, as well as identity (Grand *et al*., 2016). As a result, digital technologies were often used in conjunction with analogue technologies. The wide variety of factors influencing the use of analogue and digital technologies, for communication and engagement practices by the participants, has resulted in a muddled ecosystem of digital and analogue tools and practices. While communities can benefit from such mixed ecosystems (Grand *et al.*, 2016), through the mixing of skills and competencies, this can cause challenges when individuals work across communities, as seen with the experimental physicist (Chapter 5, Section 5.7). This also helped demonstrate the potential for conflict within and across CERN if the distinction between practices are not recognised. This is particularly important in terms of communication. To minimise such risks, CERN could either promote a preferred set of technologies and practices, encouraging CERN Staff and Users to work in similar ways, or try and support different ways of working. While this may be harder to achieve, requiring greater time and resources, it could also be the most beneficial in terms of allowing CERN Staff and Users develop new skills and competencies, potentially leading to greater numbers of 'highly-wired' individuals within the institution (Grand *et al.,* 2016).

- *Who have CERN identified as key stakeholder audiences?*
- *What is the role of Communications Group in reaching these audiences?*

- *What routine activities do the Communications Group undertake to engage with their audiences?*

Through the document analysis, a number of key stakeholders were identified. As outlined in Chapter 4, Section 4.1.2, these key audiences have become more detailed and specific with the development of each Communications Strategy, with the latest 2012-2016 Communication Strategy (CERN, 2011) containing eleven well defined audiences. This research carried out with the CERN Communications Group illustrates how using the rhetorical strategy of 'publics-in-particular' (Michael's, 2009) has helped the group identify and define diverse audiences. As demonstrated throughout the case studies, with such definitions, the Communications Group have been able to utilise appropriate technologies and methodologies to reach these audiences.

To identify the role of the Communications Group in reaching these audiences, a suitable analytical framework to categorise the participant's activities was required. Within this thesis, Fahy and Nisbet's (2011) typology of media professionals was used to categorise individual members based on their activities. Throughout the case studies, various types were observed (summarised in Chapter 6, Section 6.1, Table 6.1). Fahy and Nisbet's (2011) 'Conduit' type was particularly apparent across the participants, an observed role of the Social Media Manager (Chapter 5, Section 5.1), the UK Communications and Innovations Officer (Chapter 5, Section 5.2), Internal Communications Manager (Chapter 5, Section 5.3) and the Head of Press (Chapter 5, Section 5.4). Other types were also witnessed within individual cases, including the 'Convenor' role of Social Media Manager, who uses social media to facilitate direct interaction between physicists and publics, the 'Agenda-Setter' role of the Head of Press, who uses Press Releases and contacts with external journalists to draw attention to important issues that are then picked up by other media outlets. Yet, these various roles and associated practices were primarily underpinned by their roles as 'Advocates', aiming to promote the work of CERN rather than provide impartial, balanced reporting. In this respect, the various members of the CERN Communications Group were characterised by their scientific public relations practices, using various channels to build, maintain, and when necessary repair, relationships with various audiences.

Borchelt and Neilson's (2014) levels of public relations allowed the identification of a number of individual *Programme* level activities aimed at specific stakeholder groups and actors in the Circuit of Mass Communication (Miller *et al*., 1998). Decision Makers can be reached through such activities as the UK Communications and Innovations Officer's fortnightly newsletter sent directly to the UK Science Minister and key advisors within the UK Government. The Head of Press and the relationships they build with journalists through Press Releases and Media Visits can influence media, while a range of publics can be directly engaged with through the work of the Social Media Manager. Finally, Science Institutes can be reached through internal communications and interactions with external High Energy laboratories.

The set of *Programme* level activities observed within this thesis seemed effective and well suited to the actors and stakeholders they were aimed at, indicating success at Borchelt and Neilson's (2014) *Functional* level, helping to manage and maintain relationships with these groups. Furthermore, many of these programmes also achieve at the *Organisational* level, with activities such as those of the UK Communications and Innovations Officer helping to maintain support for CERN from the UK Government. Finally, it could be argued that the group achieve at the *Societal* level, with many of the Communications Groups programmes not just aimed at building trust and the reputation of CERN, but in High-Energy Physics more broadly through continued work with physics institutes across the world.

- *Where does the CERN Communications group sit within the process of mediation of scientific information?*
- *What is the role of scientific public relations in the Circuit of Mass Communication?*

While many researchers have focused on the practices of journalists and media professionals in the digital age (Allan, 2006; Allan and Thorsen, 2009; Trench, 2007), the work of scientific public relations professionals and their role within in the dissemination of big science remains an under researched area. As Borchelt and Neilson (2014) describe, scientific public relations plays an increasingly prominent role in science communication, with scientific organisations using public relations activities to develop relationships with a range of stakeholders, end-users and publics, in order to gain and maintain support for the work of the organisation. As such, this research sought to identify the role of public relations groups, such as the CERN Communications Group, in the process of mediation of scientific information (Miller, 1999) and their position within Miller *et al's.* (1998) Circuit of Mass Communication. To achieve this, two main analytical frameworks were used to explore the various roles of the CERN Communications Group, Fahy and Nisbet's (2011) typology of science media professionals and Borchelt and Neilson's (2014) functions of public relations within the sciences.

Across the case study's, scientific public relation functions were readily identified as a primary aspect of many of the participant's roles, including the Head of Communications, UK Communications and Innovations Officer, Head of Press, Social Media Officer and Internal Communications Manager. Within these cases, while the participants were observed building and maintaining relationships with all actors in the Circuit of Mass Communication (Miller *et al.*, 1998), the primary focus of the Communications Group is on relationships with news media. As demonstrated in the Head of Press case study (Chapter 5, Section 5.4), the Group are able to use this relationship to extend coverage of CERN's work. In some respects, the Communications Group are able to benefit from the increasing reliance on the newsgathering techniques of journalists, providing a cheap and accessible source of information to specific 'vetted' journalists. As such, the Communications Group are able to shape the HEP news agenda at an early stage. Such practices are concerning to those who see the rise of public relations in science as detrimental to critical journalism (Davis, 2009). Either way, this scientific public relations function of the Communications Group, intent on achieving positive coverage for CERN, plays a significant role in the process of mediation of HEP information.

This thesis has demonstrated the breadth of functions public relations groups have within the Circuit of Mass Communication (Miller *et al.,* 1998). As shown in Chapter 6, Section 6.1,

Figure 6.1, while the majority of these functions may focus around relationships with news media, public relations groups like CERN's play a broader role, facilitating interactions with the other actors in the circuit. This is generally achieved through collating and repackaging knowledge coming from the experiments into appropriate forms for their audiences, such as press releases for media professionals, social media posts for particular publics and newsletters for internal audiences. However, while Miller *et al's.* (1998) Circuit of Mass Communication provided a useful framework within this thesis, it became clear that the actors within this circuit do not fully represent the diverse audiences involved within this process. With the Communications Group identifying a broad range of 'publics-in-particular' (Michael's, 2009), and increasingly utilising social technologies, they will engage more directly with publics, diversifying their audiences and modes of communication and engagement.

8.2 Reflection on the Methodological Approach

As outlined in Chapter 3, a mixed methods approach was used within this thesis to explore the ways in which CERN research becomes public in an era of digital scholarship, and its implication for academics and media professionals. Here, ethnographic observations, semi-structured interviews and document analysis were used within a framework of complementary assistance (Morgan, 1998) to explore the Research Question and Sub-Question (Chapter 2, Section 2.6). While unable to find studies that have explored communications groups within similar research institutions to CERN's, the decision to use such an approach came after reviewing those that used a combination of methods to explore the impact of technology on working practices in other contexts, especially newsrooms (e.g. Boczkowski, 2004; Lawson-Borders, 2003; Meier, 2007). With this lack of literature, document analysis provided a valuable starting method within this thesis (Bowen, 2009). The analysis of strategic documentation, especially the various CERN Communications Strategies (e.g. CERN, 2006; 2008; 2011), helped identify how such strategies developed, the structure of communications and a number of issues this structure creates.

Along with the document analysis, ethnographic observations proved a particularly useful method (Hammersley, 2007). As described in Chapter 3, Section 3.3.3, ethnography can allow researchers to gather rich empirical data to find the way in which technology is used, the factors that influence its use and the social relations that are formed around it (Boczkowski, 2002). Similarly, observations were used within this study to trace the participant's use of technology for communications and working practices. Observations were also key to understanding the function of the Communications Group in a situation where empirical research about such groups was lacking (Hammersley, 2007). Combined with interviews, this provided a useful insight into the roles of significant members of the group (see Williams, 2010; Lowery, 2010; Boczkowski, 2009). Yet, there were a number of methodological issues that emerged during the observations. One issue was the language barrier during the observations, with some interactions between members of the Communications Group carried out in French. Within this thesis, methodological triangulation helped minimise the negatives effects of this language barrier, with participants asked to clarify these moments during the interviews in English, minimising any subjective interpretation on the part of the researcher. Furthermore, the ability to observe participants practices, such as the use of technology, was unimpeded by language barriers.

While it is argued that the selected methods and methodology were well suited within this research, if repeated, some changes and additions would be made to the approach. Based on my experience from this thesis, a participant observer approach could be adopted from the outset, providing a more in-depth experience. Utilising a participant observer role within further studies, especially during focused observations, would bring me closer to the participants and their practices, potentially giving access to additional data (i.e. Press Releases, blogs, and evaluation sheets). Having a more involved role within the group for a longer period of time, extending beyond naturalistic observations, could provide a richer experience and more detailed data. Care would still need to be taken over the amount and complexity of data collected. This issue could be exacerbated within a participant observer approach due to increased closeness to the participants (Domingo, 2003).

This thesis could also have benefitted from some additional forms of data collection. A focus group activity involving all of the Communications Group could have facilitated the analysis of similarities and differences in attitudes from a variety of its members, generating data through interactions (Kitzinger, 1994). This would have allowed a larger number of participants to be involved at once, more so then in the interviews or individual observations (Kitzinger and Barbour, 1999). As such, the various opinions and attitudes of the Communications Group towards the organisation of CERN, openness and use of digital technology could have been explored through social interactions, with participants using their own language and frames of reference (Kitzinger, 1994). This could be particularly effective in similar circumstances as the CERN Communications Group, who work through social interactions. This aspect of the group was only partially explored through attendance at meetings within this thesis. However, care has to be taken when involving pre-existing groups within such activities, especially where certain hierarchies may be present (Kitzinger 1994). In an organisational setting such as CERN's, members of the Communications Group may feel unable to express their opinions with their managers or senior figures present within a focus groups. Hence, a mixed method approach would still be used, with focus groups used alongside individual semi-structured interviews and observations.

As described above, there is an absence of studies into the role and function of public relations groups within HEP institutions. While this thesis has demonstrated how such groups function within HEP, the nature of the research and its organisational context will have a significant impact on communication practices and openness. As such, the role and function of Communications Groups in other organisations and across other disciplines is likely to vary. Similarly, use of technology and digital scholarly practices will also vary greatly within teams and organisations. To explore these issues in other contexts, future research in other scientific organisations could benefit from the adoption of a similar exploratory approach as used within this thesis.

8.3 Final Remarks and Recommendations

Within the sciences, openness is as relevant today as it ever was. Furthermore, developments in technology, openness and communication have been continuously linked. It's argued the development of the Gutenberg press was a central factor in the scientific revolution (Kurtz and Brody, 2006), with the quick and relatively inexpensive reproduction of scientific results allowing for the establishment of ideas and practices related to 'open science' (Davis, 2009). Additional social and cultural factors and increased opportunities for the dissemination of knowledge allowed for the easier transmission of information (Peter and Deimann, 2013). Now in the 'digital age' (Holliman, *et al*. 2009), digital technologies provide further formal and informal channels through which 'producers' can reach 'consumers' of knowledge more directly (Holliman, 2012; Allan, 2006). Such changes have led to what Borgman (2007) and Weller (2011) describes as 'digital scholarship', where technology is integral, ubiquitous and often ambient, and yet not always regarded straightforwardly as work. In this respect, digital technologies are used not just to create new knowledge, but also to inform, educate, entertain and at times engage wider sections of society in increasingly novel ways.

This thesis set out to explore how the concept of openness, and the emergence of digital technologies, influenced the organisational culture of CERN and the practices of CERN researchers and communications professionals. A significant part of this thesis has focused on an increasingly important mediator in the digital age, public relations groups within scientific research institutions (Borchelt and Neilson, 2014). The primary contribution of this thesis has been to this discussion around the role of public relations in the process of mediation of scientific information. I argue that digitally-mediated scientific public relations is integral to the process of mediation, yet has so far been unrepresented within it. As described in Chapter 2, Section 2.4.5, a great deal of focus is placed on the relationship between public relations groups and external media professionals (i.e. journalists). While an important relationship, this thesis has demonstrated the broader roles such groups play within research organisations, often directly connecting research and researchers with a range of publics and stakeholders. To achieve this, multiple gatekeepers will often exist with such groups, controlling their own gates through their own gatekeeping mechanisms. Within this thesis, the Head of Press, Social Media Manager and Internal Communications Manager were all seen as gatekeepers, controlling the gates between external media professional's, publics and internal audiences. This further demonstrates the potential for public relations groups in scientific organisations to control their image, not just through the news media, but through direct contact with relevant stakeholders.

While the CERN Communications Group place a great deal of focus onto building and maintain relationships with external media professionals, the actions of the other members makes the group more than just a media relations unit. Arguably one of the most significant relationships for the Communications Group is with the CERN community. As shown in the case of the Internal Communications Manager (Chapter 5, Section 5.3.), a close relationship with the research community can enable a greater flow of information from the experiments out into the public sphere. On the other hand, a negative relationship can limit this flow of information and create a 'them and us' mentality amongst the researchers. A negative relationship can be caused when public relations professionals try to take too much control over the flow of information. As this thesis has shown, public relations groups can dictate how information coming from the research community is transmitted and framed. Tensions can arise when the research community doesn't agree as to how information should be shared[99], creating greater alienation between researchers and public relations professionals.

What's clear from this thesis is the continuation of asymmetrical public relations functions (Bauer, *et al.,* 2007) within CERN. Across the various practices observed, there was little indication of a two-way, symmetrical approach to public relations, with little feedback received from publics/stakeholders. Even with the Social Media Manager, who can facilitate some form of engagement, primarily use social media as an educational/one-way public relations tool. There is significant room within the Communications Group to carry out further evaluation of their practices. This should involve increased feedback from the targets of their public relations activities, not only to help frame activities better, but to also allow for more meaningful engagement. This will, however, require additional funding and expertise to carry out such evaluation effectively.

While this thesis has gone some way to show the role of public relations groups within HEP, further research is required in a variety of fields to fully understand the impact of such public relations practices across the sciences. Nevertheless, the updating of Miller *et al's.* (1998) Circuit of Mass Communication within this thesis to include public relations can provide an analytical framework for future work in this area. Caution should be taken, however, when it comes to the actors outlined in this model. As this thesis has demonstrated, the audiences and stakeholders involved within this process are diverse,

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[99] For an example of this tension see Chapter 7, Section 7.3.1.

often requiring tailored channels to be reached. The actors provided within this model should only be used as guides and not strict categories. Instead, further models are needed that address the complex set of actors involved in this process, with actors and audiences thought of in terms of 'publics-in-particular' (Michael, 2009), with specific channels through which they interact.

As well as placing scientific public relations within the process of mediation of scientific information, this thesis also set out to explore how digital scholarship is enacted within HEP. As an organisation, CERN is a meeting of scholarly and professional practices, mediated, to some degree, by digital technologies. This thesis has shown how despite the wide adoption and use of digital technologies by researchers and professionals at CERN, the associated digital scholarly practices are yet to be fully realised. Instead, a muddled culture of practices (Grand *et al.,*2016) exists across CERN, with multiple analogue and digital tools used by individuals and groups working in distinctly separate ways. Within such groups there is a potential for conflict if people feel pressured to work in a particular way or if practices are not recognised/supported. Similarly, the variation in working practices between communication professionals and researchers can cause issues when it comes to communication. Combined with the ease of DIY communication technologies, and an already distributed communications network, there is a genuine risk to the reputation of the organisation. Finding a balance in this situation may be impossible within such a large, multi-national organisation. Yet, the large, distributed network of researchers that make up such big science projects could be their greatest asset when it comes to communication and engagement with a broader range of publics. Instead of controlling the use of DIY communication technologies, investment is needed to create strategies and guidelines that support and encourage individuals and groups when communicating and engaging. Support and training mechanisms should be in place to encourage groups or individuals in their communication activities, such as social media training for researchers. Such support and training could help develop groups of digitally engaged researchers with the skills to communicate and engage themselves to the benefit of both science and society. Furthermore, communication strategies, adopted across the institution, particularly at the level of senior management, are crucial to creating a shared understanding around communication and engagement. The creation of such strategies should take into account the views of multiple stakeholders, rather than just the views of communication and engagement professionals. Brining in the views and opinions of multiple stakeholders, combined with an increase in numbers of digitally engaged researchers, could help achieve the desired shift towards symmetrical models of public relations.

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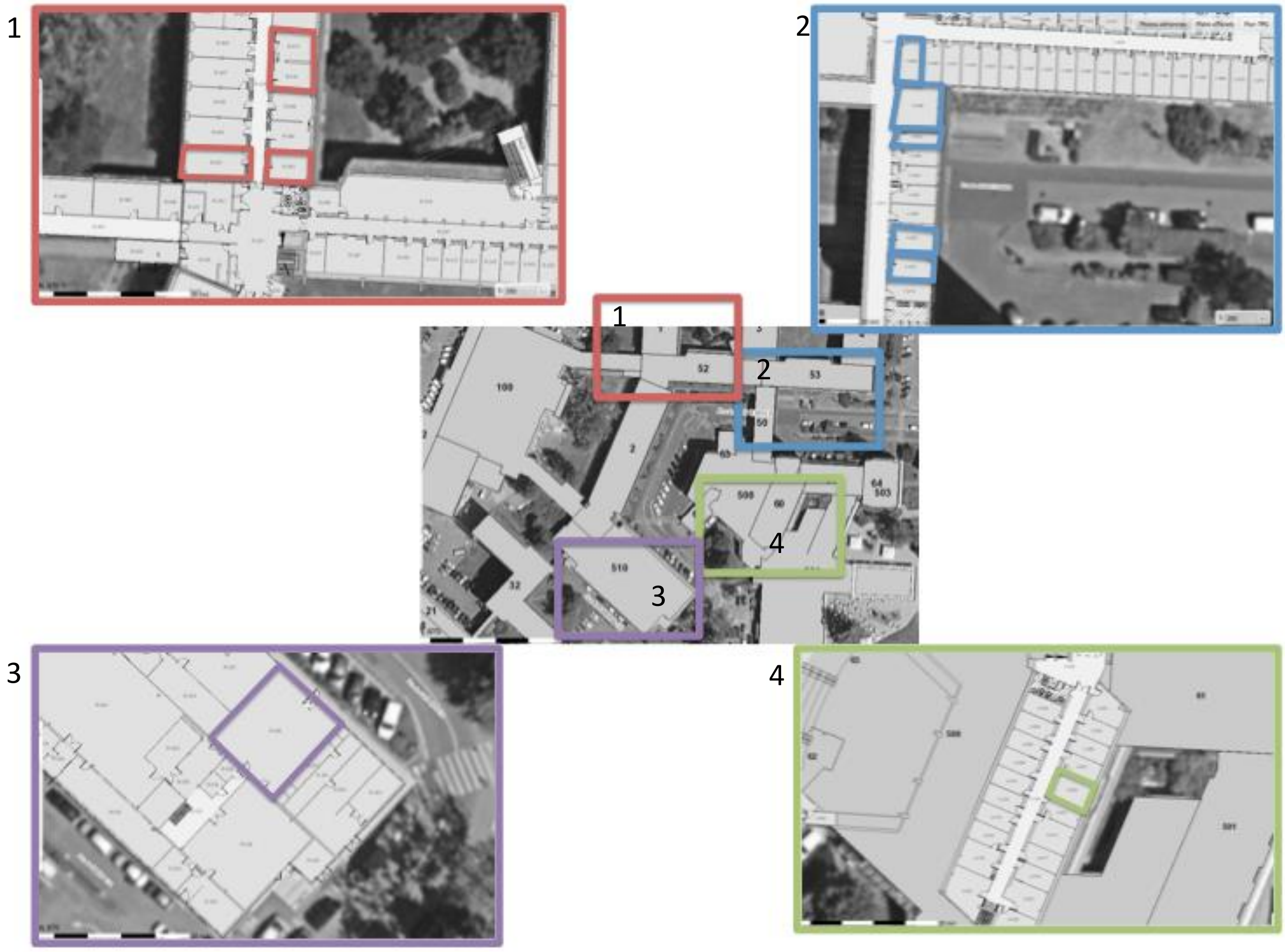
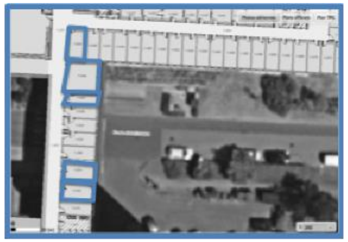
Appendix A: The distribution of the CERN Communications Group

MAIN MAP AND ROOMPLACEMENT



ROOM PLACEMENT | ROOM DETAIL

1


2


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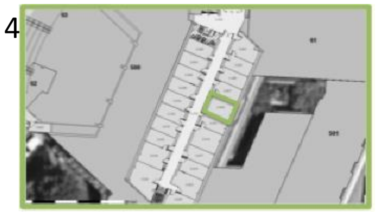

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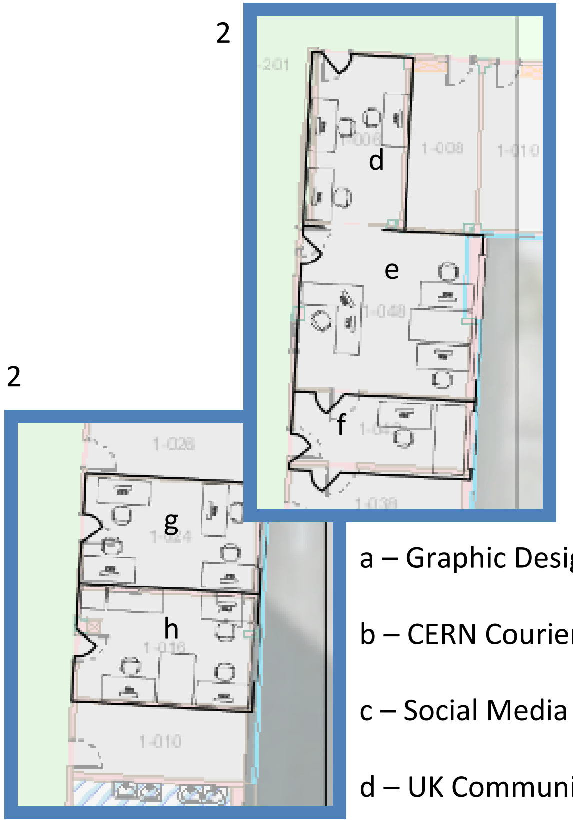

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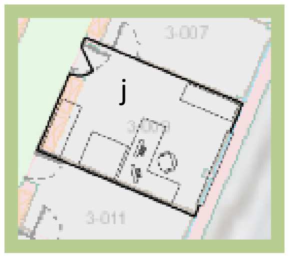

a – Graphic Design team

b – CERN Courier

c – Social Media Manager

d – UK Communications and Innovations

e – Press Team/Local Communications

f – Head of Press

g – CERN Bulletin

h – Web Team

i – Audio/visual Department

j – Head of Communications

Appendix B: Observation protocol

ACTIVITY OBSERVATION SHEET

Date:………………… Observing:……………………… Position:……………………

Time	Activity	Location	Medium	Outcomes	Comments

Appendix C: Invitation and Consent Form

Dear [add name here]

I am contacting you to ask you to participate in an interview study as part of an Open University/CERN-sponsored research project: 'Exploring "Digital Scholarship" within a climate of openness and transparency: promoting the Large Hadron Collider and high-energy physics'.

The main aim of this project is to explore aspects of science communication and public engagement in the digital age through what will ultimately become a case study of aspects of scientific research conducted at CERN. Such a study will allow me to examine the interplay between public engagement with high-energy physics and the emergence of ideas about digital scholarship, conducted within a context where openness and transparency are valued.

The main area of investigation will be how those working at CERN use digital communication channels for all aspects of the research cycle, interacting with fellow members of staff (including those in the Press Office), communicating with media professionals (e.g. journalists), and engaging with members of the public.

The primary focus will be on the relationships between these social actors and the challenges they face when utilising these digital channels for communication and engagement. The work of the CERN Press Office will also be examined to explore how digital technologies are used to communicate and engage aspects of work conducted on the Large Hadron Collider (LHC).

The purpose of these interviews is to:

- map activity under three broad themes: communication; engagement; and information;
- explore the relationships between CERN's Communications Group, scientists working at or associated with CERN, and journalists/ media professionals;
- identify the values that underpin CERN's public engagement and outreach policies;
- review how digital technologies facilitate interdisciplinary collaboration;
- consider how the issues listed above are influenced by CERN's culture of openness and transparency.

The interviews will last for approximately 60 minutes. They will be recorded, transcribed and analysed as part of this project by me and members of my PhD supervision team (Dr Richard Holliman and Professor Eileen Scanlon). Interview participants will be given an opportunity to review an interview transcript for accuracy. Participants will also be kept informed and updated with the progress of the research and how the information obtained has been used. The interview data will also be used in future reports and research publications. Your name will not be used in any publications, but your role will be listed.

I will be visiting CERN in the near future to conduct the interviews. Can you please offer potential dates for this interview between the 23rd and 29th of November?

Best wishes
Jamie Dorey

Research student
Centre for Research in Education and Educational Technology
The Open University
E-mail: Jamie.Dorey@open.ac.uk

Consent form for interviews with CERN employees: Exploring Digital Scholarship practices at CERN

The main aim of this project is to explore aspects of science communication and public engagement in the digital age through what will ultimately become a case study of aspects of scientific research conducted at CERN. Such a study will allow me to examine the interplay between public engagement with high-energy physics and the emergence of ideas about digital scholarship, conducted within a context where openness and transparency are valued. The main area of investigation will be how those working at CERN use digital communication channels for all aspects of the research cycle, interacting with fellow members of staff (including those in the Press Office), communicating with media professionals (e.g. journalists), and engaging with members of the public. The primary focus will be on the relationships between these social actors and the challenges they face when utilising these digital channels for communication and engagement. The work of the CERN Press Office will also be examined to explore how digital technologies are used to communicate and engage aspects of work conducted on the Large Hadron Collider (LHC).

To begin the empirical research I am conducting interviews with key staff working at CERN. The purpose of the interviews is to:

- map activity under three broad themes: communication; engagement; and information;
- explore the relationships between CERN's Communications Group, scientists working at or associated with CERN, and journalists/ media professionals;
- identify the values that underpin CERN's public engagement and outreach policies;
- review how digital technologies facilitate interdisciplinary collaboration;
- consider how the issues listed above are influenced by CERN's culture of openness and transparency.

Jamie Dorey

Research Student

jamie.dorey@open.ac.uk

I, (print name in full) ________________________________agree to participate in this interview being conducted as part of an Open University/CERN-sponsored research project.

I understand that I can withdraw from the interview at any point and that the interviews will be recorded, transcribed and analysed by Jamie Dorey and members of his PhD supervision team (including Dr Richard Holliman and Professor Eileen Scanlon). I understand that excerpts from the interviews may be quoted in reports and other forms of publication, and that I will not be named in these reports, but my role will be identified.

I grant authorisation for the use of the above information, with the understanding that all the data provided will be stored on secure servers at The Open University and CERN, and will be held under the terms and conditions of UK data protection legislation. I understand that the data collected will only be used for research purposes, and that these data will not passed on to any third parties.

Interviewee's signature: Date

Researcher's signature: Date

Appendix D: Interview Protocols

Interview Protocol: Communications

Name: ___________________ Title: ______________________ Date:________

Email: _________________________

Interviewed by: Jamie Dorey

Introduction

The information you provide today will help me identify initial areas of interest for my PhD study. My study as a whole intends to explore how ideas around digital scholarship have shaped the communication practices, engagement activities and information sharing procedures of those working at CERN. My interest today is in learning from your experiences as part of CERNS communications group, the relationship you have with scientists working at or associated with CERN and journalists/media professionals.

Interviewee Background

How long have you been in your current position at CERN?

Have you held any other positions at CERN?

Questions

1. To begin, can you briefly outline the various roles of the communications group within CERN?

?? Probe what's the most significant role

2. How would you define your role within the communications group?
3. Could you outline how the 'Communication strategy 2012-2016' came about?

?? Probe past communication strategies

?? Role and purpose

??Probe is it working? What needs to be improved?

4. What kind of relationships and interactions do you have with scientists?

?? Probe how does this vary between steady state and heightened state

5. What kind of relationship and interactions do you have with journalists?

?? Probe the difference between steady and heightened state

??Probe for the overall process of turning experimental data into a media product

6. Has the emergence of new technologies changed the ways in which you communicate?
7. Have digital technologies created any particular challenges?

?? Probe the issues surrounding the blogging of results etc.

8. How does the communications group support CERN's commitment to openness and transparency?

[depending on time I may went to ask about how media coverage of CERN is tracked and evaluated and how this is used.]

Interview Protocol: Engagement

Name: ___________________ Title: ______________________ Date:________

Email: _________________________

Interviewed by: Jamie Dorey

Introduction

The information you provide today will help me identify initial areas of interest for my PhD study. My study as a whole intends to explore how ideas around digital scholarship have shaped the communication practices, engagement activities and information sharing procedures of those working at CERN. My interest today is in learning from your experiences as [outreach coordinator] and identify the values that underpin public engagement at CERN.

Interviewee Background

How long have you been in your current position at CERN?

Have you held any other positions at CERN?

Questions

1. To begin, can you briefly outline the role and remit of your department?
2. Where does your department fit within CERN's communications strategy?
3. Why does CERN commit resources to engagement activities?

?? Probe for CERN's definition of engagement?

3. What audiences are targeted through these engagement activities?

?? Probe mandated and non- mandated audiences. How were they defined and by who?

?? Probe do you manage to engage with all these audiences?

4. What evidence is there to suggest that these audiences value such activities?

?? how is the impact of events measured?

5. Is support/ training made available for those wanting to engage with the public? What does this entail?

?? Incentives

6. How does CERN's strategies for openness and transparency impact on the engagement activities you provide?

Interview Protocol: Information

Name: ___________________ Title: ______________________ Date:________

Email: _________________________

Interviewed by: Jamie Dorey__

Introduction

The information you provide today will help me identify initial areas of interest for my PhD study. My study as a whole intends to explore how ideas around digital scholarship have shaped the communication practices, engagement activities and information sharing procedures of those working at CERN. My interest today is in learning from your experience of using digital technologies to collaborate across disciplines.

Questions

1. What is your department's role within CERN?

2. What types of digital technologies are used to communicate and collaborate at CERN?

?? Probe why are these used?

?? Importance of TWIKI in particular

3. What benefits have new technologies brought?

?? Probe impacts on types of collaborations

??Impacts on openness and transparency?

?? Handling of big data sets?

4. What challenges have new technologies brought?

?? Issues over re-skilling of users?

??Openness and transparency

?? Big data set

5. How are CERN's data systems organised?

?? Probe storage and back up

?? Use of cloud storage?

6. What does Openness and transparency mean to CERN?
7. What implications do CERN's openness and transparency strategies have for data handling and data storage?

Interview Protocol: Scientist

Name: ___________________ Title: ______________________ Date:________

Email: _________________________

Interviewed by: Jamie Dorey

Introduction

The information you provide today will help me identify initial areas of interest for my PhD study. My study as a whole intends to explore how ideas around digital scholarship have shaped the communication practices, engagement activities and information sharing procedures of those working at CERN. My interest today is in learning from your experiences working at CERN, the interactions you have had with CERN's communications group, media professionals and fellow scientists, and your experience with public engagement at CERN.

Interviewee Background

How long have you been in your current position at CERN?

Have you held any other positions at CERN?

Questions

1. Have you had any direct interaction with the Communications team?

?? If yes, probe when this was, what it entailed and with whom. Was it related to a specific event?

2. Have you been involved in any public engagement work during your time at CERN?

?? If yes, probe when this was, the type of event. Was training/ support provided?

?? If no, probe why not? Is there a Lack of opportunities? Do they feel like they lack the skills? Do they see public engagement as part of there role?

3. Have new technologies impacted on the way you communicate and work with fellow scientists?
4. [Depending on answers to question 1 and 2, have new digital technologies impacted on the way you communicate with media professionals and the public?]
5. How does CERN's openness and transparency strategies impact on the way you work and share data?

?? Probe the impacts of digital technologies